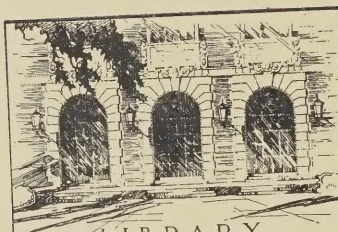

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BULLETIN of the
ATOMIC SCIENTISTS of CHICAGO

VOL. 1 FEBRUARY 1, 1946 360 NO. 4

Atomic Energy Legislation:

THE ATOMIC SCIENTISTS BACK THE McMAHON BILL

The Federation of Atomic Scientists was invited to testify before the Senate's Special Committee on Atomic Energy on the subject of atomic energy legislation, particularly, the McMahon Bill, S-1717. Dr. Harrison Davies, of the Clinton Laboratories at Oak Ridge, the representative of the Federation, was heard on Jan. 28. His testimony, the result of the joint efforts of the site groups, follows:

I am here this morning to present the views of the Federation of Atomic Scientists, composed of scientists and engineers who have worked on the Manhattan Project. For several months we have studied the various proposals for domestic legislation on atomic energy. As scientists we desire legislation which will foster research and development in the field of atomic energy and will preserve the freedom necessary for the further advance of science. As citizens we fear unwise laws on atomic energy for the same reason other citizens fear them: we too value our lives.

Long before the atomic bomb fell on Hiroshima we realized that it would affect political and economic ideas all over the world. While the rest of the world was preoccupied with war, we came to the view that our work might well have more far-reaching results than the winning of the war itself.

While we debated the issues and strove for a plan which might secure safety for the world and yet realize the full benefits of atomic energy, we lacked advice from other quarters. With the release of the bomb and the introduction of atomic energy legislation into the Congress, it became possible to form organizations, seek expert opinion in other fields, and publicize our views. We have done our best to add to our technical knowledge of atomic energy some understanding of the complex political, legal and economic features of the problem.

The Federation of Atomic Scientists has developed a set of policies which our members believe should be embodied in atomic energy legislation. We now have the opportunity to compare our aims with the provisions of a specific bill. The McMahon Bill satisfies these aims in great detail. The men who made the bomb are for the bill. I wish to report to the Committee that S-1717 has the strong support not only of more than fifteen hundred Manhattan Project scientists and engineers, but of thousands of other scientists.

I appear here today empowered by the groups which make up the Federation of Atomic scientists to tell you why we like the McMahon Bill; why we think that with a few minor changes designed to strengthen the obvious intent of the bill, it will be the best practical solution of the problems of domestic legislation.

Any bill should include two aims: security for the country and exploitation of the peaceful benefits of atomic energy. With these in mind, we have examined S-1717 in terms of: (1) contribution to the hope of peace; (2) stimulation of research and development; (3) provisions for studies and reports by the commission; (4) administrative structure.

INTERNATIONAL CONTROL AND THE NATIONAL SECURITY

There can be no real national security in a world in which many nations possess atomic weapons. There can be no solution of the problem of security short of an effective international control of atomic and other weapons of offense, and of the elimination of war as a method of settling international disputes. Any domestic legislation must, therefore, encourage the international control of atomic energy. We believe that S-1717 fulfills this requirement. The problem of the production of atomic bombs is treated specifically; responsibility is so fixed that international regulation must take precedence. In this respect, we feel that the addition of a general section stating explicitly that international agreements will supplant the

(Continued on Pages 4 and 5)

Control Problems:

3. Control of a Gaseous Diffusion Plant

This article, the third of a series, is a condensation of an analysis by Dr. M. Benedict of the Kellex Corporation. The previous articles dealt with a general survey of the control problem and with the control of uranium mining.

The gaseous diffusion process is one of the most practicable means for the production of an explosive for atomic bombs. Any system of international control of atomic energy must contain provision for the inspection of the world for evidence of unauthorized construction of diffusion plants and for the inspection of operating plants to prevent the diversion of U-235 into unauthorized uses, such as bombs.

There are three principal questions which should be investigated:

First: Can a system of worldwide inspection be devised which will insure that no gaseous diffusion plant will be **constructed** without the knowledge of the international control authorities? It is believed that an effective system can be devised, provided a sufficiently elaborate arrangement of overlapping inspections is instituted.

The second question is a related one: Can a system of world-wide inspection be devised which will insure that a diffusion plant is not **operated** without the knowledge of an international control authority? The point here is that plants may be built before the inspection system is devised. It is thought such plants could be made very difficult to detect.

The third question: Assuming that the location of all operating plants is known, can a system of inspection be devised which will prevent a s i g n i f i c a n t amount of uranium 235, in a gaseous diffusion plant, from being **diverted** to uses not authorized by international control agencies? It is felt that the probability of such diversion is small and the amount of material potentially divertible can be reduced, but that neither of these can be made negligible in an operating plant.

The assumptions which have been made in arriving at these opinions are: first, inspectors will have free access to

(Continued on Next Page)

CONTROL OF A GASEOUS DIFFUSION PLANT Cont'

all parts of the world and all industrial establishments which they must visit in the pursuit of their duties. That does not mean there will be an inspector on every block, but that if a man has to have certain information on a particular plant he will be allowed to enter and inspect all parts of it. Secondly, all nations will be aware that inspection is carried out: It won't be done as an OSS job, but through accredited inspectors.

Detection of Plant Construction

There are three principal types of activity which would be used as evidence that diffusion plant was under construction, (1) research and development in connection with the process, (2) manufacture of equipment for the process, and (3) construction of the plant proper.

(1) Research and development work would have to be done on diffusion barriers, on centrifugal blowers and on other types of equipment. If inspectors were periodically to visit research establishments it would not be difficult for them to determine that work of this character was being done. However, there is no way of establishing that all the research institutes of a country were visited. Thus, inspection of research establishments, while it might make construction of the diffusion plant more difficult, would not of itself insure detection.

(2) There are a few key pieces of equipment which have be manufactured in tremendous volume for a diffusion plant. The principal ones appear to be diffusion barriers, centrifugal blowers, valves, bellows, and pneumatic instruments.

Centrifugal blowers appear to be most readily amenable to inspection, though diffusion barriers are the most distinctive features of a diffusion plant. There are so many different types of material which could be used for barriers, and it would be possible for another country to manufacture them in so many different ways, that one would not know where to station inspectors nor what to look for. Valves, metal bellows, instruments, are all articles of commerce and an inspection system to check on items of this character would really be a very difficult and possibly a fruitless undertaking.

(3) The tremendous size of the diffusion plant appears to be the most likely means for insuring the detection of its construction. The principal features of construction of a diffusion plant, like any other large engineering undertaking are: preparation of the site, erection of buildings, accumulation of materials of construction, procurement of the power supply, assembly of large numbers of construction workers, and assembly of a significant number of engineers, scientists and other technicians. The construction of the diffusion plant above ground will involve the movement of large quantities of dirt, which constitutes an obvious change in the surroundings.

An enormous building, or a large number of smaller buildings, would be required to house a diffusion plant. A large amount of freight would have to converge on the point or points at which the plant was being erected. Some 33,000 carloads of freight were shipped to one point in connection with the construction of our Diffusion Plant. At the peak of construction, 25,000 workers were employed. A staff of over 1,000 engineers was assembled. All of this would be evidence of large scale activities which warranted further investigation by the inspectors.

The construction of the American Plant took about two years and during at least a year of that time there was obvious evidence of large scale construction activities.

For these reasons, it is believed the following inspection procedures would insure the detection of construction of diffusion plants: Firstly, periodic aerial surveys should be made at one year intervals of the entire land surface of the earth; secondly, resident inspectors would have to be stationed in all cities large enough to house a diffusion plant with the probability of its not being observed from the air; and thirdly, it would be necessary to inspect, at intervals of one year, mines and other underground enclosures large enough to house a plant.

An additional possible check is the observation of the commerce of a country, in order to know what types of freight are being shipped to what areas, to assist the geographic search for the construction of a plant.

While it is probable that each one of the inspection methods suggested would detect the construction of a diffusion plant in most cases, it is felt that it would be necessary to use all of them to insure the detection of a plant under construction with a high degree of probability.

To be acceptable, an inspection system must not demand an excessively large inspection staff. The aerial survey of plants could be done simultaneously with the exploration of the surface of the earth for uranium mines. Additional personnel would be unecessary if one were already committed to inspect the earth for new mines. Similarly, plant inspection in large cities, could be incorporated with other inspection activities, and therefore might not require a large number of additional personnel. Nor will the centrifugal blower inspection require a large number of people. There are probably now no more than 30 or 40 plants in the world which could do the job in the volume required. The one type of inspection which would
for many people is the check of freight traffic of the world. It wo
probably be opposed by practically ev
country, on a number of grounds.

Control of Plant Operation

When the inspection system is set
can one account for everything going
in the plant? The view on this is so
what pessimistic. It would be very
ficult to determine exactly how m
uranium 235 is being produced per
and what was being done with it.
diffusion plant is an extremely com
cated and extensive asssemblage of
kinds of equipment. Over 600 miles
piping of assorted sizes are in the An
ican Diffusion Plant, and it holds ne
a million cubic feet of a gaseous
nium compound. Contrast with
the volume of Uranium 235 produ
per day which is only a fraction o
cubic foot.

Because of the tremendous size of
plant an appreciable fraction of
plant's production disappears each
through legitimate losses. Thus,
matter how carefully one measured
amount of 235 charged to the plant,
could never hope to account for al
it in the product and waste shipped f
the plant. Some will disappear in
process even in an honorably run p
The initial efficiency of recovery in
plant may be improved during o
tion, and the material recovered thr
increased efficiency may be divert
improper uses.

In the American Plant, one gue
that from one to five bombs per
could be produced from non-acc
able material if one sought to
material improperly.

The principal conclusion is: i
wish to be sure that no uranium
being diverted from uranium is
separation plants, we had bette
build such plants in the first plac

If this is so a well-planned e
of any inspection system of ope
plants could succeed at least to a c
extent.

There are some who are more
istic and contend that simple ch
in operation could greatly redu
danger of diversion.

COMMITTEES:

Publicity and Contacts
(Chairman—K. Way)

Meetings Mondays, 4:30 P.M.,
208 in Jones Chemistry Bld
Speakers Bureau ....A. S. Lan
Radio and Newspapers ....R. A
Magazines ....K.
Organizations ....H. F

Materials
(Chairman—L. I. Katzin)

Meetings Fridays, 5 P.M. in
208 in Jones Chemistry Bl
Legis. Research ....F. L. Fri
Records ....R. L. Pl

CONGRESSIONAL NEWS . . .

SENATE HEARINGS ON ATOMIC ENERGY

The Senate Committee on Atomic Energy resumed its hearings on Jan. 22. It is expected to hear witnesses on domestic legislation for a period of three weeks. Below we continue our brief reports of the testimony.

Jan. 22, Harold D. Smith, Director, Bureau of the Budget: Mr. Smith's testimony was limited to a consideration of the feasibility of the structure of the proposed Atomic Energy Commission as set up in the McMahon bill. While approving of the bill in general and of its exclusion of the military in particular, Mr. Smith criticized several administrative features of the bill. He felt that (1) the internal divisions of the Commission should not be set up by statute at this time, but left to the discretion of the Commission, (2) the Commission should be provided with a single administrative officer in order to promote efficient administration, (3) the Division heads should be appointed by the Commission rather than by the President to avoid division of responsibility, (4) the size of the Commission should be cut from five to three members, and, (5) the Commission should not be given the powers to create corporations.

Mr. Smith thought the members of the commission should be "broad gauge" men and not specialists in one field (as scientists or military men.) Senator Hickenlooper suggested that the Commission should be representative, i. e. include scientists, and certainly a military man, at least for the duration of the present emergency period.

William H. Davis, former Economic Stabilizer: Mr. Davis strongly objected to the mandatory provisions for the compulsory licensing of patents in the atomic energy field. He agreed that the Commission must have the power to enforce compulsory licensing where it deems such action in the public interest, but feels that such action should be at the discretion of the Commission.

Davis stated that he would like to see the army announce what the energy stored in its present stock of atomic bombs could accomplish for the good of mankind if the material in them were used for peaceful purposes. Senator Hickenlooper countered this with the opinion that it would do a lot of good in the international situation if the army would announce that we had enough bombs to blow any other country off the face of the earth.

Jan. 23, Harold L. Ickes, Secretary of the Interior:

"The McMahon bill, S. 1717, is carefully designed to safeguard the progress and the freedom of science while maintaining the integrity and supremacy of civilian government. These objectives of S. 1717 are close to my heart. I am entirely in accord with their major implications.

I agree that our national safety and our industrial progress depend upon our doing the biggest job of scientific research that has ever been done in the world; that we cannot leave that research to private initiative and industry; that the Federal Government, with all of the aid that it can get from the colleges and private laboratories, must shoulder the main burden of that task, while leaving free the road of private scientific research; that the Government must be empowered to maintain full access to all private scientific developments in this field, to own all patents and materials, and to control all military and industrial applications of atomic energy in such a way as to protect the public safety; that at the same time the Government must give increased attention to the social and economic possibilities, as well as to the physical and medical implications of atomic fission; that any control agency set up in this field should be responsible to the President of the United States and not to an irresponsible super-government; and that whatever is done by such a control agency must be open to the broadest scrutiny and congressional supervision based upon the regular and detailed reporting of agency activities. A democracy cannot afford to keep secrets from itself.

The underlying theme of S. 1717 is that scientific progress and scientific freedom are indivisible; we cannot advance the cause of science and civilization by making research a crime. This cannot be said of some other bills which have been introduced in this field.

I think that the distinction is wisely drawn in S. 1717 between the realm of discussion and experimentation, where freedom is the only safe rule, and the realm of applied technology, where, in a matter that involves the national safety and welfare so vitally, social control is essential. The control that S. 1717 would impose upon the commercial production of fissionable materials and their utilization in industrial channels seems to me to be entirely justified. If the push of a button can destroy a city, no nation can afford to leave the button in private hands. That would amount to an abdication of sovereignty.

This bill is designed to maintain the integrity and supremacy of civilian government. That seems to me to be a matter of very great importance.

We have only a little time in which to negotiate with other nations for a security which cannot be achieved by a monopoly of knowledge or by specific military defenses, a security which must be based upon the international sharing of knowledge and adequate international inspection and policing. That kind of agreement can better be achieved if the control of atomic energy is in civilian rather than military hands. I do not blame the military for suspecting and preparing for the worst from all other nations. That is its job. But you cannot successfully negotiate an international agreement unless you start with the assumption that it will be advantageous to all the parties concerned.

If you look at this problem of atomic energy only through military binoculars all that you can see is the threat of future wreckage, to which the only answer is more wreckage. Even the destruction of enemy cities at the outbreak of a war would not provide an adequate defense. Presumably enemy storage and transmitting areas may be located in uninhabited sections of desert relatively immune from attack. If we want security for our homes and our children—not just the uncertain satisfaction of hoping that in an atomic war we might kill sooner more of the enemy than they could of us, we are going to have to gain that security by working out arrangements of mutual advantage with other nations. Nor will that job be facilitated if we make atomic energy control a function of the military.

We need to have civilian control of atomic energy in the interest of the development of our Nation and of industrial and medical progress, as well as in the cause of world peace and true national security.

If I am correct in believing that commercial use of fissionable materials is not an immediate possibility, I think that there might be some advantage in leaving for future congressional consideration the terms that should govern the disposition of fissionable materials. After all, we can't solve at once all of the problems that atomic fission puts before us. Whatever legislation is enacted this year must be considered interim legislation, to be amended when our knowledge of the subject is greater than it is today. This matter of the disposition of the sources of atomic energy might very well be left for some other time when we are better informed than we are today of the economic ramifications of the problem. True, that would leave our legislation incomplete. But completeness may be a false goal in interim legislation."

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Atomic Scientists Back McMahon Bill

provisions of the bill will enhance the prospects for obtaining effective agreements. Furthermore, the provisions of the bill for the domestic development of atomic energy are such that international control can be introduced without serious domestic dislocation. A commission, responsible to the President and to the Congress, controls the production and the distribution of fissionable materials; the commission has full powers of inspection and can require reports on all work in the field; private monopolies are not permitted; premature industrial development which might prejudice international agreements, by the creation of vested interests and by complicating the inspection problem, are not allowed.

STIMULATION OF RESEARCH AND DEVELOPMENT

Vigorous research and development in nuclear science must be maintained. The use of the fission phenomenon and its by-products in physical, chemical, biological, medical and industrial research, as well as in power development, should greatly enrich our country and indeed all mankind.

Bill S-1717 will foster such research and development through equitable distribution of fissionable material and of by-product materials to all research workers, by granting funds to independent research organizations — such as universities, private and industrial laboratories — through the widest possible dissemination of information, and by creating a division of governmental research to insure a complete program.

The provisions of the bill for allocation of fissionable and by-product materials are the best guarantee for rapid development in the field of atomic energy. No requirement other than the capacity to satisfy health and safety standards is set forth. We consider this requirement sufficient.

Independent research is encouraged by the bill. Government research is not preferred above private research in the allocation of funds. We regard this as a highly desirable feature of legislation in the atomic energy field or for that matter, in any other scientific field. The full development of science rests upon independent research by many individuals in many laboratories throughout the world. The direction which scientific research will take at any time cannot be predicted nor can research be completely guided by even the most intelligent administrator or scientist. Ideas come from the most unexpected sources. Scientists in a well-staffed, well-equipped laboratory may work on a problem for many years and yet those new and revolutionary ideas which may completely change the complexion of their work can come from a single scientist or from a small group working in a poorly-equipped laboratory in a small country. It is, therefore, of the utmost importance that problems be studied by many independent groups and individuals. All competent scientists should be allowed to study the problems of atomic energy and to obtain the materials and such funds as are necessary for their work.

The Bill provides for the wide distribution of by-products, such as the radioactive products. The use of these materials as tracers or "tagged atoms" in the study of biological, chemical, medical and industrial processes will, we believe, lead to the first peacetime applications of fission. Study of the by-products themselves will advance our knowledge of the fundamental properties of matter.

The dissemination of basic scientific information and, when possible, related technical information, is made mandatory. The bill, in fact, attempts to provide the freest possible exchange of scientific information. We strongly approve of such provisions, and feel they should not be abridged. Science cannot prosper in secrecy. Science cannot develop when workers in a particular field may not discuss problems with those in similar fields. The wide publication given to fundamental scientific discoveries in the last forty years is largely responsible for rapid scientific development. The fact that S-1717 encourages this point of view is applauded by the atomic scientists. For similar reasons we would like to see the force of the patent section maintained in guaranteeing freedom for use in this field of all discoveries and inventions.

We approve the security regulations of the bill. During the war most scientists not in the armed forces worked on secret war projects. Secrecy regulations were based on the Espionage Act and successfully denied important information to the enemy. We feel the Espionage Act will provide as much national security as can be found in a policy of secrecy. We are pleased that the McMahon Bill bases its security regulations upon this Act and does not set up any further power to make arbitrary secrecy regulations.

STUDIES AND REPORTS BY THE COMMISSION

The American people have a large interest in the development of atomic energy. Progress and policy in this field should be subject to public scrutiny. The bill provides that the commission shall submit quarterly reports to the President and to the Congress. These reports must detail the activities of the Commission and

THE ATOMIC SCIENTI
THE FEDERATION OF

The first Council meeting o
Federation of American Sci
(FAmS) is reported on the last p
this issue. The success of this or
tion will determine to a large
whether American scientists will
to exercise their full influence in
ing the national and internationa
cies in the "atomic age."

The FAmS grew from a nucleus
ed by the Federation of Atomic
tists (FAtS) — a central organ
of the five associations, form
scientists at the various "sites"
Atomic Bomb Project.

The desire for immediate extens
the FAtS to include scientists o
the Atomic Bomb Project came
two sources. In the first place,
Project scientists, particularly a
Alamas, were leaving the Projec
felt that they could best continu
work by organizing new grou
scientists in the colleges to whic
were going, and bringing them in
Federation. In the second place,
sire to collaborate equally wi
"atomic scientists" arose spontan
in several non-project groups o
tists.

Because of the desire of these
for integration, the formation
FAmS came at a time when
Atomic Bomb Project groups —
those at Chicago and Clinton -
not quite satisfied that the FA
already achieved all that the
achieve, or that they should be
diately absorbed by the larger o
tion. While the desirability of a
ganization open to all America
tists who want to work for enli
of the public on the implica
atomic power was recogni
at these sites, two points appe
be in need of clarification, wh
time could bring.

First, from a purely tactical
view, a certain — even if large
served — prestige was and is
tached to the group of scient
have actively participated in
ation of the atomic bomb.

Secondly, the work on the A
Bomb Project has put an indelib
on the minds of practically all
who took part in this work.
dently of their political affiliati
all were and still are overwh
the realization of what an at
will mean to this country an
world. They are, therefore,
subordinate all other tasks
organization of scientists ma
take, to a single aim — that of
an international control of at
pons and making wars impos
the proper organization of th
It remains to be seen w
similar unity and uniqueness

AN SCIENTISTS

be achieved in a nation-wide organ-ation, open to all scientists—not only an initial resolution, but also in prac-al, everyday work. With this in nd, the Atomic Scientists of Chi-go, as well as several other Atomic mb Project groups, while joining the deration of American Scientists, pre- that the Federation of Atomic ientists be maintained as a separate tity, working in close and friendly operation with the newer group.

In the past, American scientists have en represented by two kinds of organ-tions—the academies and profession- organizations such as the National ademy, The American Chemical So-ty, or The American Physical So-ty, and organizations of "socially con-ous" scientists, such as the American sociation of Scientific Workers. The fessional organizations are "non-itical." In practice, some of them con-er the defense of the professional tus of their members sufficient son for taking a definite stand on ny political issues.

The great problem before the FAmS to avoid leaning in either of these directions. The Federation must engage in a fight for the profes-nal standards of scientists, nor be-ne tinted with a definite political or. The Atomic Scientists organiza-ns have succeeded, in the short pe-d of their existence, in impressing ge sections of congressional and pub-opinion by their complete devotion to one task at hand—prevention of mic war — and their independance of professional or partisan political tives.

This was not easy, particularly the case of the fight against the May-nson Bill, which could easily be—and ually was—interpreted by some ob-vers as motivated by the scientists' cern for their traditional free and luded "way of life." The attitude of FAtS on the question of the "atom-bomb secret" also lent itself to mis-erpretation in terms of political parti-ship.

The ASC, in joining the FAmS, does s in the hope that this organization l steer the same straight course, by centrating on what we think is the in problem of our time, and in con-cting its fight for the solution of this blem in such a way as to avoid all ap-rance of political partisanship. The atest disaster for our cause would be allow it to become a subject of divi-n between "left" and "right". The iding time must be between intel-ence and short-sightedness, between lerstanding and lack of imagination; aim is—and must remain—to en-hten all, not to rally a sympathetic tion.

Atomic Scientists Back McMahon Bill

must include the commission's program for the following quarter. Thus the work of the commission is constantly in the public view and a means is provided for insuring that the commission will act in the public interest. The atomic scientists look to the continuing interest of Congress to insure the development of atomic energy for the maximum public benefit.

Further, the bill provides for studies of the social, political and economic implications of atomic energy and that these studies shall be reported as a basis for new legislation, particularly with regard to future industrial uses. New developments in atomic energy will be studied from the point of view of their effect on our national economy and a sound basis will be provided for future developments. In addition, international agreements will be facilitated since premature or uninformed legislation on such questions as the future large-scale use of atomic energy will be avoided.

Bill S-1717 encourages research and development in the field of industrial application of atomic energy. The policy of postponing large-scale industrial applications is, in our opinion, a wise policy. Industrial processes should certainly be developed, and the bill provides adequately for their development. Widespread industrial application, on the other hand, may present us with new difficulties. The economics of atomic power development are too uncertain to permit a decision at this time. Furthermore, premature development of special interests in this field may prejudice the possibility of international control. The possession by individuals or private groups of the facilities for producing fissionable material — the production of power may be accompanied by the production of fissionable materials — would greatly complicate the problems of international inspection and control.

It is worth emphasizing once again that strong government control, based upon a government monopoly of the production of fissionable materials, protects us from the misuse of these materials and prepares us for the possibility of an effective international control system.

ADMINISTRATIVE STRUCTURE

The composition of the commission has been discussed by the Committee. Two hostile viewpoints have been presented. The commission, it is said, should be small for the sake of efficiency. On the other hand, the commission should be large in order to permit representation of the many groups whose affairs touch upon the commission's activities. We believe that the commission members should have but one interest, the public welfare. A need for further coordination among government agencies and the Commission can perhaps be achieved through the presence of representatives of such agencies at the commission's deliberations. In our judgment the number of commissioners should not be decreased. It is essential that their appointment be full-time.

We wish to go on record most strongly as favoring complete exclusion of the military from any policy-making function on the commission. By this we do not mean to exclude efficient liaison between the commission and the armed forces. Provisions making this liaison mandatory as suggested by Secretary Forrestal would not be opposed by the Atomic Scientists. However, it is in the best tradition of American government that policy be made by civilians. A subject fraught with such tremendous significance to our foreign policy as the development of atomic energy in this country must certainly be freed from every vestige of military control.

The administrative structure of S-1717 seems very satisfactory. Some of the functions of a future commission have now been recognized and the bill provides for them. Thus, Divisions for production, allocation, research, and military application are established and their directors charged with the day-to-day supervision of these activities. This arrangement should leave commissioners free to formulate policy.

The system of Presidential appointment and removal eliminates the possibility of insulation against review and against change. The policy-making function of the commission, together with the delegation of administrative duties to the Divisions, makes real the functions of the appeal boards provided for by the bill. Were the commissioners also the administrative officers, we feel appeals would have little meaning, since they would be directed against those people who had already formulated the policies and made the decisions.

There are a number of minor changes, designed to clarify the bill's intent that we could suggest. We should be glad to submit those to this Committee, if it so desires. We have not brought them forward in this testimony, since we do not wish to divert attention from the important points. The major questions we have discussed and the treatment by the bill of these questions leads us to regard S-1717 as a very good bill. The atomic bomb project scientists strongly urge its rapid enactment into law.

THE DISTRIBUTION OF URANIUM IN NATURE

Ordinary uranium is the basic raw material for the production of atomic energy. The only known sources of atomic energy which are of practical significance are the fissionable isotopes, uranium 235 and plutonium 239, both of which are obtained by the processing of ordinary uranium. Since, according to competent authority, this situation will very likely persist for some time to come, an evaluation of the world resources of uranium is of paramount importance to an understanding of the future role of atomic energy. There are two aspects to the problem. The first is the total amount of uranium available, the second deals with accessibility.

Uranium is of very wide distribution in nature. The radioactivity of uranium affords a very sensitive test for its presence; consequently innumerable specimens of rock, water, and vegetation have been analyzed for their uranium content. So extensive is the available data accumulated in the last fifty years, that it is possible to answer the question of how much uranium is present in the world with a reasonable degree of certainty. About 95% by weight of the earth's crust consists of the igneous rocks, granite and basalt. The average uranium content of these rocks is 0.004%, or about one-seventh of an ounce of uranium per ton of rock. Granite rock, such as constitute the Appalachian Mountains, contains a rather higher proportion of uranium than does basalt; in granite there may be as much as one ounce of uranium per ton of rock. The earth's crust is so heavy that even these very small percentages represent a huge total uranium content. The weight of uranium near the earth's surface has been estimated to be 10^{15} (1 followed by 15 zeros) tons. The oceans also contain minute amounts of uranium, with a total uranium content of about ten billion tons. It is interesting to compare the uranium content to other more familiar elements. There is more uranium present in the earth's crust than cadmium, bismuth, silver, mercury, or iodine. Uranium is about one thousand times as prevalent as gold.

While uranium is thus seen to be omnipresent in the rocky portions of the earth's crust, the number of places where uranium occurs in concentrated form is relatively small. Even so, uranium in quantities large enough to be visible to the naked eye has been found on every continent and almost in every country. About one hundred uranium containing minerals have been identified. These occur in quantities ranging from a few isolated crystals to ore deposits estimated to contain thousands of tons of uranium. Of the latter, only four deposits were know before the war. Small occurrences have been found in Europe in Sweden, Norway, Germany, Czechoslovakia, France, Belgium, Portugal, Italy, and European Russia. All of these except the Czechoslovakian (St. Joachimsthal) deposits are, as far as is known, either very small, or of very low uranium concentration. In Africa, uranium minerals have been found in Cape Provinces, at Morogoro on the East Coast, and of course, in the Belgian Congo, where the world's reputedly richest deposits exist. Uranium also occurs on Madagascar in amounts which were once considered great enough to warrant commercial explotation. In the Western Hemisphere, large deposits are know to occur in Utah and Colorado in the United States, and in the North Territories of Canada. In addition there are scores of small occurrences in Ontario and Quebec, and in various parts of the United States (North Carolina, Connecticut, Texas, North Dakota). Uranium has also been found in Mexico and Brazil. Fairly extensive deposits are known to exist in Russian Turkestan and India, and small amounts are present in Australia, New Zealand, and Japan. The actual magnitude of the so-called small deposits is a difficult matter to establish. It is not unlikely that further exploration near the regions known to contain uranium may reveal much larger quantities than had previously been suspected.

Hitherto, the decision to commercially exploit a given uranium deposit was dependent entirely on the costs of producing radium from it. The uranium was strictly a by-product. On this basis, only the Belgian Congo and the Great Bear Lake deposits in Canada have been able to compete in the world market. The deposits at Joachimsthal and in Colorado were unable to do so.

Now, of course, this situation has changed completely. The use of uranium for the production of atomic bombs and for the potential production of power has shifted the interest from radium to uranium. Furthermore, the use of uranium piles will completely eliminate the demand for radium.

From a broad point of view, as much uranium can be obtained as organized society finds worth while. Ores are commonly mined which contain only one-fifth of an ounce of gold per ton of rock. Now, vast quantities of rock exist which contain from one-fifth to one ounce of uranium per ton of rock. If society decides uranium to be as valuable as gold, then practically unlimited quantities of uranium are available for use in supplying atomic energy. For instance the carnotite ores of Colorado can be made to yield large amounts of uranium.

While uranium at the price of gold may not be able to compete economically with common sources of energy, there is little question that as far as atomic bombs are concerned, monetary considerations are not pertinent. In the event of an atomic armament race, survival demands uranium, and every country will strain its resources, if necessary, to attain a sufficient supply. Insofar as controls and inspection are concerned, it appears that any country can secure as much uranium as would be necessary for atomic warfare. The problem is whether a country could secure large amounts of uranium without a good probability of detection. This question can best be considered in the light of what is known about uranium deposits.

There are at present four regions in the world where uranium occurs in such quantities that ordinary mining operations suffice to yield considerable amounts of uranium. These are the pitchblende deposits of Canada and the Belgian Congo, the relatively less important carnotite sandstones of Utah and Colorado, and the minor pitchblende deposit at Joachimsthal. In two regions (Canada and Africa), there is enough uranium to make it possible to obtain one ton of uranium from fifty to one hundred tons of ore. In the other two cases perhaps five times as much crude ore must to be mined per ton of uranium. As far as is known, these four deposits are geologically unique. Each one differs from the others, and it is not unlikely that they represent really rare geological phenomena. Even intensive exploration, based on previous experience, will probably not reveal more than a small number of similar occurrences. Their number is at present so small as to render surveillance a rather easy matter.

The situation would be radically different if an attempt was made to use granite as a source of uranium. In order to obtain one ton of uranium, it would be necessary to quarry somewhere between 40,000 and 250,000 tons of rocks. While this is technically feasible, it is an enterprise of such a magnitude as to render concealment impossible. The operations would require a great deal of heavy machinery, large numbers of workers, immense amounts of explosives and chemicals. Extensive transportation facilities and, in general, huge plants would be essential. These could scarcely be hidden.

It thus appears that inspection of uranium mining operation may provide at least a fairly satisfactory mode of control. However there is the possibility of the discovery of very rich deposits, with the resultant ability to obtain large amounts of uranium in an unobtrusive fashion. The only sure way of eliminating this possibility would be an intensive prospecting campaign of those areas of the earth which have as yet received little attention.

NTERNATIONAL NEWS . . .

NO CREATES ATOMIC ENERGY COMMISSION

The UNO Assembly, at its first meet- g on Jan. 13, referred the Moscow re- ution on the atomic energy commis- n to its Security and Political Com- ttee. The Committee recomended the option of the resolution without anges. On Jan. 24, the Assembly ted 47 to 0 to set up the 12-nation nmission.

We present the following report of dresses given during the first two eks of the UNO meeting.

Prime Minister Atlee: "We on these ands, which were for so long immune m attack behind the barrier of the , feel perhaps more than any others t we are living in a new age. The velopment of powerful weapons of truction operating from distant bases destroyed the illusion of isolation- . The coming of the atomic bomb s only the last of a series of warnings mankind that unless the powers of truction could be controlled immense n and almost annihilation would be lot of the most civilised portions of nkind.

welcome, therefore, the decision to nit the whole problem of the control atomic energy to a commission of the ited Nations Organizations. In this covery we can see set clearly before in tangible form the question that es the modern world. Here is an ention fraught with immense pos- lities, on the one hand of danger and, the other, of advantage to the hu- n race. It is for the people of the rld through their representatives to ke their choice between life or th."

an Masaryk, Czechoslovak Foreign nister: "The armaments industry, to- her with the latest devastating in- tions—physical, chemical, biological, chological or sociological—should be under the control of the United Na- ns." He expressed the hope that "not particle of uranium produced in choslovakia would ever be used for olesale destruction and annihilation." We want our uranium," he declared, do exactly the opposite—to build, safeguard, to raise the standard of ng, to make our lives more secure efficient. To this we wish to de- ate our uranium mines. Please help

sked if "the output from mines uld be open to international inspect- ?" he replied, "yes, I hope so."

ec'y of State Byrnes: "The report ls upon us to join in creating a com- ssion to study, from the point of view international control, the problems ated by the discovery of atomic ener- and of other forces capable of mass truction.

"It calls upon us to find ways which will permit and promote the use of our knowledge of the forces of nature for the benefit of mankind under safeguards which will prevent their use for destructive purposes.

"In meeting these problems we must realize that, in this atomic age and in this interdependent world, our common interests in preserving the peace far outweighs any possible conflict in interest that might divide us.

"I hope that the General Assembly will promptly approve the resolution which is before it. I hope that the commission will promptly set to work on its tasks. It will be comforting to the peace loving peoples of the world to know that we are moving promptly to endeavor to find ways to avoid a race in armaments."

Senator Connally: "In performing its work the commission must obviously operate within the framework of the powers conferred on the UNO by its Charter.

It is authorized to make recommendation but not to compel action on the part of any States. Each State will be free to consider the acceptance or rejection of the commission recommendation in accordance with its own constitutional processes."

Mr. Peter Fraser, Prime Minister of New Zealand: "We are not completely satisfied that the procedure suggested in the resolution is the best possible. While the problem of atomic energy has important security aspects, it has other aspects also related to the opportunities which it offers for the benefit of mankind.

"We think that a better account would be taken of this many-sided nature of the problem if the commission were to work under the direction of the general assembly.

"This seems to us to be particularly important at the present exploratory stage when the first task, even before making any recommendation, will be to define the many complex issues involved in this vast problem."

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without asking whether this control can be achieved by international agreement or only by world government.

It was pointed out that if the public is made fully aware of the importance of preventing atomic war and if it finds that the UNO is unable to provide this security, it may then turn to World Government as the only satisfactory solution. Therefore, insistence on the dangers of an atomic war and the necessity of international controls may be more effective than direct appeals for World Government.

EMERY REVES ON WORLD GOVERNMENT

On January 17 and 18, two meetings devoted to a lecture and discussion on the subject of World Federation were jointly sponsored by the ASC and the U. of C. Office of Enquiry. The speaker was Emery Reves, author of "Anatomy of Peace." The meetings were made possible by Mr. Hamilton Holt, President of Rollins College. Mr. George Holt presided.

Mr. Reves presented the thesis that no agreement between sovereign nations can solve the problem of war, and consequently, international control of atomic energy is useless—and perhaps impossible—as long as severeignity is not transferred from individual nations to a world federation. He suggested that working for immediate creation of such a federation is at least as important as an attempt to achieve UNO control of atomic weapons. The functions of the world federal government may at first be restricted to security matters and interstate trade, but they must be based on overwhelming military force.

In his opinion, Britain and many smaller countries are quite ready to accept world federation. In the U. S., the attitude towards world government is more favorable than it is commonly assumed to be. Mr. Reves appealed to the atomic scientist, whose influence on public opinion he described in glowing terms, to join in an attempt to enlist newspapers, radio commentators, churches, etc. in a campaign for World Government.

If Russia or other countries cannot be persuaded to enter the Federation at once, it must be created nevertheless by the nations who are ready to accept the scheme. However there must be a clear understanding that the Federation is not directed against any nation, and it will acept any nation willing to join, at any time, without regard to the internal economic or political structure of that nation. (On this point, his view differs from that of the "Union Now" group). He stated that Russian policy is based on fear and mistrust of our intentions rather than on deliberate aggressiveness, and that we can expect Russian cooperation if we succeed in demonstrating to the USSR that we have no hostile intentions against her economic system and that we sincerely desire her cooperation.

In the lively discussion which followed the speech, several members of the ASC objected to the speaker's criticism of the UNO; others defended the ASC policy of concentrating on the technical problems of atomic energy controls,

GROUPS NOW STUDYING ATOMIC ENERGY CONTROL PROBLEMS

Within the past two months, many groups have been formed to study atomic energy control mechanisms. A listing of the most important of these groups will help clarify their relationship.

1) The UNO atomic energy commission was established on Jan. 24 by a unanimous vote of the General Assembly. This commission resulted from the preparatory T-A-K and Moscow conferences.

The commission will consist of representatives from the following 12 nations: U.S., U.S.S.R., Britain, France, China, Canada, Brazil, Australia, Poland, Egypt, Mexico and the Netherlands. It will report to the Security Council whose members are the same nations with the exception of Canada.

2) Sec'y of State Byrnes appointed a committee headed by Under-Secretary Dean Acheson to study the controls and safeguards necessary to protect this government. This committee is to instruct the American delegates to the UNO commission.

3) On Jan. 25 the State Department announced the formation of a board of consultants, to aid the Acheson committee. The board will consist of David E. Lilienthal, chairman of the TVA; Chester I. Barnard, president of the N. J. Bell Telephone Co.; J. Robert Oppenheimer, California Institute of Technology; Charles A. Thomas, vice-president of the Monsanto Chemical Co., Harry A. Winne, vice-president of the General Electric Co. Lilienthal will be chairman of the board.

4) A committee was appointed in January by Sec'y of War Patterson to facilitate the preparation of classified material for study by the Senate's Special Committee on Atomic Energy and by other authorized officials. This committee will integrate the classified material on inspection which has now been prepared under compartmentation restrictions at the various sites. It will report directly to Gen. Groves.

The members of the Committee are: Luis A. Alvarez, U. of California; Robert F. Bacher and Philip Morrison, Los Alamos; Manson Benedict, Kellex Corp.; Frank H. Spedding, Iowa State; Spofford G. English, Plutonium Project; Chauncey Starr, Electromagnetic Project; Lyman H. Bliss, Union Carbon and Carbide Co.

5) Stemming from a formal request by Sen. McMahon, the Federation of Atomic Scientists has prepared a series of reports on inspection systems. These are based on classified material and are written by teams of experts at the various atomic bomb project sites. The reports will be transmitted to the War Dep't. committee for integration.

The Federation of Atomic Scientists is also preparing a coordinated nonclassified report based on the secret data. This report will be sent to the Senate Committee on Atomic Energy.

6) Another group which will study control problems in a less official capacity was formed on Jan. 5 in N.Y. at the joint conference of the Federation of Atomic Scientists and the Carnegie Endowment for International Peace. The members of the group are: James T. Shotwell, chairman; Clark Eichelberger; Edward H. Shils; Daniel Melcher; I. I. Rabi; Paul F. Kerr; R. H. Crist; John A. Simpson; Irving Kaplan.

THE FEDERATION OF AMERICAN SCIENTISTS COUNCIL ELECTS OFFICERS

On January 5 and 6, the first Council meeting of the FAmS took place at the Institute of Physics in New York. The following group attended:

Member Organizations: Rochester (66 members), B. D. Boche (official delegate), C. Stern; Chicago (200), J. A. Simpson (delegate), R. M. Adams, E. Rabinowitch; Los Alamos (350)—V. W. Weisskopf (delegate), B. T. Field, W. W. Woodward; Manhattan Project, New York (400)—I. Kaplan (delegate), F. T. Miles, C. D. Swartz; New York (City) (500), A. Nordsieck (delegate), Miss M. Philips, H. C. Wolfe; Oak Ridge (Clinton Lab.) (165)—J. H. Rush (delegate), H. Brown, H. Curtis; Pasadena (57)—R. M. Noyes (delegate), Philadelphia (310) —A. T. Fusfeld (delegate), T. S. Hauschka; Rocket Research Group (Allegheny Ballistics Lab.) (85)—J. B. Rosser (delegate). Total: 2067 members

Organization which had not yet joined the FAmS: Cambridge scientists (about 150)—L. H. Ridenour; Dayton—C. L. Rollinson; Oak Ridge (Separation plants) (about 400)—J. A. Armitage and W. C. Beard.

W. Higinbotham was elected chairman, H. C. Wolfe, secretary of the meeting.

The following candidates received the largest number of votes for the members of the Administrative Committee: Higginbotham, Simpson, Rush, Morrison, Ridenour, Schiff, Miss Philips, Powers, Wolfe, Feld.

Originally it had been decided that the first five be members of the Administrative Committee; the next five to serve as alternates. This decision was later altered by increasing the number of members to seven, so as to include Miss Philips, as one of the three candidates (Higinbotham, Rush, Philips) who agreed to serve full time in Washington. Higinbotham was then elected chairman, Miss Philips, secretary, and Rush, treasurer.

Midwest Conferen[...] With Religious Lea[...]

The ASC has organized a th[...] conference of religious leaders [...] scientists on the Problems of the Atomic Age. It will be held during the first week in February at the University of Chicago. The conference will be attended by prominent mid-west representatives of every important religious group in the country. It is to be the first in a series of conferences designed to reach the leaders in the different branches of our national life — religion, labor, farm group etc.

The principal speakers will be L. Szilard on the Physical Principles, Historical Background and Possible Future Developments of Atomic Energy; R. E. Zirkle on the Biological and Medical Hazards and Benefits of Atomic Energy and H. C. Urey on A Scientist Views the World Situation.

The chairmen of the sessions will be Profs. Warren C. Johnson and H. I. Schlesinger of the Dep't. of Chemistry U. of Chicago. Round-table discussions will be led by Profs. Quincy Wright (International Law) and Louis Wirth (Sociology) both of the U. of Chicago.

About twenty members of the ASC will attend the round-table discussions. The chairman of the program committee is R. J. Moon.

More on

SENATE HEARINGS

James Forrestal, Sec'y of Navy: Th[e] testimony of the Secretary of the Nav[y] was limited to the military aspects [of] the McMahon bill. He was concerne[d] lest, under the provisions of the bill, th[e] Army and Navy might lose all contr[ol] over the development of atomic energ[y] for military purposes. Forrestal admi[t]ted that there was nothing in the bill [to] prevent close liaison between the pr[o]posed Atomic Energy Commission a[nd] the War and Navy Departments, b[ut] pointed out that there was also nothi[ng] to require it.

He felt that the objections of the Na[vy] would be met by amending the mi[li]tary section of the bill to (1) provi[de] for mandatory liaison between the Co[m]mission, War and Navy Departmen[ts], and (2) broaden the membership of t[he] Commission to include the Vice Pre[si]dent and Secretaries of State, War, a[nd] the Navy, in order to facilitate su[ch] liaison. Forrestal believed that the Ato[m]ic Energy Commission should ha[ve] authority over the production of fi[s]sionable materials, but that the W[ar] and Navy Departments should reta[in] authority over the development of mi[li]tary applications.

[BU]LLETIN of the
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[P]EACE OR WAR WITH RUSSIA?

ROBERT M. HUTCHINS

Secretary Byrnes, on Thursday night, said that only a inexcusable tragedy of [er]rors could bring about war between the United States and Russia. The Secretary [m]ight have added that this tragedy is now being played, and in a leading role are [th]ose who are deceiving themselves—and the country—about atomic energy. They [w]ould have us believe that we know a big secret about the atomic bomb; that, if [w]e keep the secret, we shall be safe; and that we must put atomic energy under the [co]ntrol of the military in order to keep ourselves and our secret safe. This, they [sa]y, will not deprive us of goods, because peacetime applications of atomic energy [ar]e in the realm of speculation.

This argument is false in every particular. There is no secret of the atomic [bo]mb. If we act as though there were, we shall be in the gravest danger; for we [sh]all think we are protected by a secret, when, as a matter of fact, other nations [ca]n make atomic bombs in a very short time. And, if we put atomic energy under [th]e control of the military on the ground that it is a weapon, and nothing but a [we]apon, mankind will lose enormous benefits which are available here and now.

Major General Leslie R. Groves, who supervised the Atomic Bomb Project, [sa]id last week that it would take the Russians a generation to make atomic bombs. [It] took us five and a half years, starting from scratch. The War Department, by [pu]blishing the Smyth report, has told the world everything we discovered in the first [th]ree years of our work, and much that we learned thereafter. So much has already [be]en told that, if we gave other nations all our remaining "secrets", we would pro[ba]bly shorten their work by only about six months. The concensus of the scientists [wh]o made the bomb is that the Russians can make them in five years or less. [Ir]ving Langmuir, of the General Electric Company, a Nobel prize winner, and one [of] the few Americans who knows something about Russian science, says that the [Ru]ssians may be able to produce atomic bombs in about three years, and that they [m]ay then make them at a far higher rate than we can. There are no less than [tw]enty leading nuclear physicists in Russia, some of them recent importations from [Ge]rmany; and in the 790 universities of the Soviet Union there must be many more [wh]ose fame has not yet reached the outside world.

The conclusion which General Groves announced last week was that atomic [en]ergy must be regarded primarily as a weapon until permanent peace is assured. [He]nce he insisted upon military control. General Groves is wrong either way. If [at]omic energy is not primarily a weapon, then it should not be under military con[tro]l. If it is primarily a weapon, it should not be under military control either, for it [is] a weapon of such vital international importance that, like our international re[lat]ions, it should be under civilian control. We cannot allow the military to decide [ou]r fate. If atomic energy is primarily a weapon, it will be made a better weapon [if] the scientists who work on it do not have to work under military secrecy and are [fre]e to exchange ideas with the scientists of other countries. If there had not been [su]ch exchange before the war, we never would have been able to make the bomb. [Th]e leading ideas all came from abroad; and Germany, Italy, England, France, Hun[ga]ry, Denmark, and Canada were all prominently represented in the development [of] the bomb. Without the free exchange of basic scientific information America will [dro]p behind other nations in atomic energy, and, if atomic energy is primarily a [we]apon, other nations will shortly have better weapons than we.

But General Groves is wrong in saying that atomic energy must be regarded [pri]marily as a weapon until permanent peace is assured. He might just as well have [sai]d that we must regard the aeroplane primarily as a weapon until permanent [pe]ace is assured, for we must have secrets in aviation as important as any we have [go]t in atomic energy. Suppose we did regard the aeroplane primarily as a weapon [un]til permanent peace was assured. The result would be that air transportation [an]d aviation research would come under the domination of the military and that [ou]r people would be robbed of the advantages which progress in the air could give [th]em. And what is much more serious, we would be proclaiming the start of an [ar]mament race in aviation which would mean that we must abandon hope of per[ma]nent peace.

(Continued on next page)

MOMENTOUS DECISION

Senate Committee Prepares Domestic Bill

After listening for four months to scientists, statemen, industrialists and the military, the Senate Committee on Atomic Energy has retired into executive session. In the next two weeks, it expects to report to the floor a bill on domestic control of atomic energy.

The scientists have hoped that extensive hearings would awaken both the legislators and the American people to the utter futility of old-fashioned concepts of military security in the world of atomic weapons and to the desperate necessity for an entirely new departure in international relations.

These hopes have not materialized. The collected testimonies before the McMahon Committee make exciting reading; but the American people have taken hardly any notice of them. It has been too preoccupied with strikes, demobilization, and reconversion troubles. Press and radio have done little to attract attention to the preview of much greater disasters unrolled before the Senate Committee.

In the Committee itself, two of the most influential members—Vandenberg and Connally—have been absent most of the time. Several others have been only in irregular and silent attendance. The questioning has been largely monopolized by a senator whose final attitude is epitomized by his suggestion "why not lock the whole thing up."

As the Committee begins its legislative task, it has before it the McMahon bill, endorsed by a vast majority of scientists in the country, by most industrial witnesses, by President Truman and by the Secretaries Ickes and Wallace. The Secretaries of the Navy and of the Army, Forrestal and Patterson, also have testified for the bill, but have asked for some amendments.

Secretary Patterson expressed himself in favor of civilian control of atomic energy. He endorsed a full-time, three-man Atomic Energy Commission, and the principle of free publication of scientific results. In his opinion, the Army is not competent to draw the line between basic scientific research and military techniques which should be

(Continued on last page.)

PEACE OR WAR WITH RUSSIA? - - - Robert M. Hutchins

(Continued from page 1)

Similar results will flow from holding that atomic energy must be regarded primarily as a weapon until permanent peace is assured. This great discovery, comparable in importance with the discovery of fire, will be kept under military domination. The people will be robbed of the advantages which progress in this field can give them. And we shall proclaim an armament race in atomic weapons which will end all hope of peace.

An armament race in atomic weapons will end all hope for civilization. Caution requires us to accept Mr. Langmuir's estimate that the Russians may be producing atomic bombs in about three years and that they may then produce them at a far higher rate than we can. Unless we intend to go to war this minute, therefore, we must assume that in the next war both sides will have atomic bombs. There is no defense against the atomic bomb. Hence nobody can win the next war. The cities of both sides will be destroyed. Five hundred bombs of the kind we dropped on Japan can wipe out all the cities of the United States; and General MacArthur is reported to have said that we now have bombs one thousand times more powerful than those which devoured Hiroshima and Nagasaki. If we now have such bombs, we can be sure that other countries will shortly have them, too. But it is not necessary for them to have them; for one bomb of the kind we had last August is enough to destroy a city the size of Indianapolis.

There is no defense against the atomic bomb. One aeroplane can destroy a city, even if ninety-nine are shot down. The British could find no defense against the V-2 bomb; the only way they could defend themselves against it was to win the war. If the V-2's had had atomic warheads, England would have been erased; it would have had no time to win the war. The atomic bomb can be smuggled into a country by agents in peace-time, planted in a convenient location, and detonated at a convenient time. There is no way of detecting an atomic bomb underground, or in a box, which could have the size and appearance of a box for the overseas shipment of a typewriter. The atomic bomb makes possible anonymous war. Since the agent who plants it will not leave his calling card, we may be unable to tell whose agent he was.

The atomic bomb is a revolution in warfare. During the last war incendiaries and other conventional bombs destroyed whole areas, but the resulting casualties, square mile for square mile, were only fifteen percent of those caused by the atomic bomb. Evacuation and rescue work proceeded after the raids on Tokyo, but not after the atomic bomb fell at Hiroshima. At Hiroshima, where a quarter of a million people were killed or injured by one bomb in one minute, there were, before the bomb dropped, thirty-three modern fire stations. Twenty-seven of them were destroyed. Three-fourths of the firemen were casualties. The medical officer in charge of public health was killed; his assistant was killed, and **his** assistant. The commanding general was killed, and his aide, and his aide's aide, and his entire staff. Of 298 doctors only thirty were able to care for the injured. Of 2400 nurses and orderlies only 600 could work. Every hospital but one was so damaged as to be useless in the emergency. And this was the result of one bomb, and one bomb that was old-fashioned and out-moded by the time we dropped a bigger and better one on Nagasaki.

Are we going to start an armament race in weapons of this sort when we know that there is no defense against them? It is doubtful wisdom to start a race of any kind unless you think you have a chance of winning it. But an armament race in atomic weapons is one everybody must lose. To start such a race is madness. And it is cowardly as well. It is like a man who prefers to blow himself up along with his neighbors rather than make the effort to procure a peaceful settlement of their quarrels. The alternatives before us now are suicide or peace. Those who now indulge in loose talk about settling international differences by force must realize that force means war. War means atomic bombs. And atomic bombs mean suicide.

Atomic energy could bring untold blessings to us and to all future generations. The use of atomic energy for heat, light, and power on a large scale can be easily demonstrated in a very few months. When atomic power is available, distance and the scarcity of fuel will cease to influence the location of industries and communities. New industries and new communities, which, by the way, can be free from smoke, can be created anywhere because the cost of transporting the materials from which we draw atomic energy is negligible. This tremendous new force can bring unheard of new leisure to toiling humanity everywhere. To the biologist and the doctor the discovery of atomic energy is as important as the invention of the microscope. Radium has been a scarce and expensive medical tool. The waste from the Hanford atomic bomb-plant alone contains enough radioactive material to make it unnecessary ever to worry about radium again. Radioactive carbon and radioactive iodine are ready to revolutionize important areas of medicine and biology. The radioactive products of nuclear fission will give us new methods of diagnosis and therapy and new industries for the manufacture and distribution of the mate rials.

These are not dreams; they are real ities. New industries, new communiti es, more leisure, better health, and long er life—these are among the blessing which atomic energy puts within ou grasp. Think what atomic energy of fers to the veteran looking for new op portunities; to labor, looking for more jobs and greater production; to th farmer, looking for new markets an a little leisure. It offers a higher stand ard of living for all the world.

To get these things we need the frees possible research and development, con ducted in the public interest, unde civilian control. But the prime require ment is peace. Taking atomic energ away from the military would help u to get peace, for it would show tha our intentions are peaceful. At the sam time, it would in no way endanger ou security. We should stop swaggerin and rattling our atomic bombs. Othe nations will have them soon. We mu remember that an atomic war is a wa nobody can win. In a world full of ato ic bombs the settlement of internation disputes by force means that two-thir of the populations involved will be ki ed. Since disputes cannot be settled b force, they must be settled by agre ment or by law. We must therefore everything we can to promote intern tional understanding, through the e change of ideas, of scientists, of profe sors, and of students. We must do ever thing we can to create a sense of co munity in the world. We must strengt en every agency of international co-op ration, especially the United Natio Organization. But, realizing that agency of international cooperation c prevent war, we must at the same ti work and plan for a world governme and a world state, which offer the o real hope of saving civilization in t atomic age.

NOTES ON OUR CONTRIBUTORS

Robert M. Hutchins is Chancellor c the University of Chicago. His articl in this issue is an address delivere over the CBS network on March 5.

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Edward Teller is Professor of Ph sics at the University of Chicago, ar a member of the Institute for Nucle Studies. During the war he was o of the leaders of the atomic bom laboratory at Los Alamos.

ECRECY IN SCIENCE . . .

Louis N. Ridenour

There seems to be universal agree-nt that it is wise and useful to per-t and even encourage full and free plication of all the results and find-s of basic scientific work, **provided** t this is not done on a unilateral sis and that other nations will trade ir scientific results for ours. How-r, some have either implied or stated plicitly that it would not be wise for to maintain a policy of free publica-n of basic scientific work if some er nations refuse to do likewise. I ll try to show that the interests of nation will in any case better be ved by complete freedom of publica-n of the results of scientific work n by attempting to restrict the circu-on of such information to a certain up in this country, in order to pre-t its leakage to foreign nations who ght be our enemies in a future war. my opinion, this is true even if no er nation in the world has a policy free publication of scientific results. is true whether we think that we e entered an era of international ce, or believe reluctantly that we st prepare ourselves for inevitable .

is easy to make an idealistic argu-t for freedom of scientific publica-: to say that the publication of re-s is the lifeblood of science, to as-that only by demonstrating our in-ational good faith by a policy of publication can we hope to set the e for international trust and under-ding. I shall not make such argu-ts. I shall confine my remarks to desirability of freedom of scientific lication in an era of international picion, during an armaments race, even in the midst of a war.

N-MADE SECRETS

F. Kettering has said: "When you the laboratory door, you lock out e than you lock in." In the radar , we started with the same atmos-e of secrecy, the same precautions t compartmentation of information clearance of individuals, which acterized the atomic bomb project t to the end, and still characterize oday. However, we did away with t secrecy before the end of the At the end of the war, the Army publishing a magazine on radar a circulation of over 12,000. It had me apparent that secrecy cost us in iency far more than it gained us eeping the enemy in ignorance.

e use of the word "secret" for the ts of scientific investigation or the ngs of engineering is genuinely eading. Let me illustrate what I . If I say, "I am thinking of a ber, but I shall keep it a secret," I used the word "secret" in its usual e. Apart from the possibility of my g of the number, you have no way of finding out what it is. On the other hand, if I say, "I know the critical mass of U-235 necessary to make a bomb, and I intend to keep it secret," I am using the word "secret" in a very different sense. I am saying to you, not that you cannot find out what I know, but that you must find it out for yourself, without my help. This may cause you to become annoyed with me, but it cannot keep you in ignorance.

In order to be sure that I am keeping such knowledge from you, I must also keep it from most of my own people. Since it is never known, in science, which man will have a new idea, or what each man must know in order to have ideas and do the work of which he is capable, I am hobbling my own work by my belief in the usefulness of scientific "secrecy."

SIMULTANEOUS DISCOVERIES

Scientific history is full of coincidences—of cases in which two or more men, in different parts of the world, have reached the same result independently of one another's work and at the same time. Dr. A. H. Compton, an outstanding figure in the work on the atomic bomb, was awarded the 1927 Nobel Prize in physics for his dicovery of what is now called the Compton effect —the inelastic scattering of quanta by free electrons. In Holland, this is called the Debye effect, because Compton's explanation of his experiments was given independently by Debye at the very same time.

The Russian physicist Gamow, and Gurney and Condon, (who is scientific adviser to the Senate committee on Atomic Energy), gave independently and at the same time an explanation of the phenomenon of alpha-disintegration of the radio-active elements. The hypothessis of a violent splitting of the uranium nucleus based on the work of Hahn and Strassman in Germany was independently proposed and verified by Frisch in Copenhagen and by Joliot in Paris. The suggestion that plutonium would be a suitable explosive for an atomic bomb was made in this country by L. A. Turner. The Smyth report points out that the same idea occured independently to the British physicist Cockcroft, and Turner has told me that von Halban, working in France, had the same idea at the same time.

Two promising new devices for the acceleration of electrons and atomic nuclei to high energies were invented last fall by two young American scientists. One, called the synchrotron, was invented by McMillan, at Berkeley; another, the microtron, by Schwinger, at Harvard. In the summer, 1945, issue of the Journal of Physics of the USSR, a Russian physicist named Veksler published a paper describing both these devices. Actually, one of them was first suggested by Veksler already in 1943. Though the scientific shades had been down between Russia and the United States during the war, after five years Russians and Americans were doing the same thing, in the same way, at the same time. The synchrotron involves a magnet, whose design is straightforward but complicated. McMillan is presently building a synchrotron, on funds supplied by the Manhattan District. When a physicist at M.I.T., who is also planning the construction of such a device asked McMillan for his magnet design, he was told that the Army would not permit the release of information on the magnet. Whom are we attempting to handicap by such restrictions? Surely not the Russians; they not only invented the synchrotron, they did it earlier than we did.

In my own wartime field of radar there were many examples of the same kind. Radar itself was independently invented by the Germans, the French, the British, the Japanese, and ourselves. Each of the nations kept it secret from all of the others, not knowing to what little point this was done. Microwave radar. which has played such a great role in the Allied victory, was made possible by a single invention, the cavity magnetron. This is a transmitting tube which gives previously unimaginable amounts of power on wavelengths far shorter than those available to radio engineers before the war. It was invented by the British. When the British sent a scientific mission over to this country in the late summer of 1940, one of the most impressive and persuasive of the secrets they had to show us was the cavity magnetron. When the Radiation Laboratory was first set up, an attempt was actually made to keep knowledge of the magnetron localized in one group of the laboratory, not even letting the men who were working on a modulator to energize this tube know of the tube's design. Yet all this time there was in the Russian literature a paper which exactly described the cavity magnetron, and gave the results of experiments with it.

WHAT IS BASIC SCIENTIFIC INFORMATION?

In the light of all this evidence, and more which I could quote for hours, one must forgive scientists for being impatient with talk of "the secret of the atomic bomb." Today, more than eight months after the explosion over Hiroshima, the entire non-secret literature covering the immense amount of medical work on the effects of radiation and of radioactive poisons on living organisms is to be found in Section 8.70 of the Smyth report. Quoted in its entirety, it is: "Extensive and valuable results were obtained." Even in an armaments race

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ATOMIC ENERGY CONTROLS No. 5 - Control of Mineral Productior

In issue No. 4 of this Bulletin, we listed the groups studying the technical aspects of international control of atomic energy. One of these, the Committee on Atomic Energy of the Carnegie Endowment for International Peace, has now released a report of a subcommittee on "Inspection of Radioactive Mineral Production." This type of inspection has already been discussed in two articles in this Bulletin (No. 2 and 5). The report of the Carnegie Endowment Committee gives authoritative support to the point of view of the previous articles.

The committee which wrote the report consisted of Chairman, Prof. Paul F. Kerr (President of the Mineralogical Society of America, and Chairman of the Department of Geology at Columbia University); three representatives from American Institute of Mining and Metallurgical Engineers; Anton Gray (Chief Geologist, Kennecott Copper Corporation), Walter P. Jacob (former Pres ident, General Bronze Corporation), an John E. Norton (Mining Engineer, Ana conda Copper Mining Corporation), an two representatives from Geological S ciety of America: A. F. Buddingto (Chairman, Department of Geolog Princeton University) and Adolp Knopf (Professor of Geology, Yale Un versity).

Following is a condensation of th findings:

PROBLEM BEFORE THE COMMITTEE

A survey of the problem has led to the conclusion that two key elements, uranium and thorium, should be under inspection.

In the Smyth Report it is stated that the amount of U235 in a bomb lies somewhere between 2 and 100 kilograms. Routine computation indicates that at least 700 pounds of even the most concentrated uranium raw material would be required to furnish 2 kilograms of U235. To furnish 100 kilograms of U235 would require about 16 tons.

A cut-off limit far below the amount necesssary for the smallest bomb has been applied in this country during the war. The War Production Board has required a report each month from any person having in his possession or control 2,000 pounds or more of any ores, residues, or tailings containing 0.05 per cent by weight of uranium as uranium oxide. This corresponds to 1 pound of uranium oxide distributed through a ton of rock.

For purposes of international inspection, geological occurrences, specimens, samples, prospects and mines, as well as ores, residues or tailings should be reported that contain uranium or thorium sufficient to yield 1 kilogram of either element in one month.

The limit brings within the range of inspection small prospects in which an occasional specimen of rich pitchblende or some other uranium mineral may be found. It includes a possible few pounds per month or more which might be produced as a by-product from some large metal mine.

The amount of uranium required for pre-war commercial purposes is negligible in contrast to uranium consumption for the atomic bomb.

The use of uranium could be discontinued where suitable substitutions may be made. Where this is undesirable the element could be distributed in small quantities under license and inspection.

The amount of thorium required for ordinary commercial purposes is large enough to require special consideration with suitable licensing and control provisions.

AUTHORITY OF INSPECTORS

Rights and privileges granted to the United Nations inspection commission should include:

1. Access to all uranium and thorium mines for the purpose of establishing the uranium and thorium content, surveying reserve and controlling production.
2. Authority to inspect terrain adjacent to producing mines and to make geological surveys for radioactive elements.
3. The right to travel without hindrance.
4. Access to air fields for the purpose of inspection flights.
5. The right to photograph from the air and to maintain laboratory facilities for studying aerial photographs.
6. The right to maintain international guards at key points.
7. Authority for geological inspection and survey of terrain in which uranium or thorium prospects occur or may be suspected.
8. The right to maintain assay and mineralogical laboratories.

At the same time the authority carries with it the responsibility not to reveal the information obtained outside the inspection commission.

Inspection groups will inspire more confidence should they comprise representatives of several nations.

Although few centers of uranium and thorium mining now exist, in order to be thoroughly effective inspection should apply to all of the countries in the world. While the discovery of uranium or thorium in some countries is extremely improbable, it is impossible to predict that any single country will not inquire inspection.

INSPECTION AT KNOWN MINES

Inspection recommended for uranium or thorium mines now in production would follow the normal pattern ordinarily utilized in the control of mining operations.

1. A competent engineer should be assigned to be in charge of inspection at each producing mine.
2. A completely independent and reliable assaying and sampling department should be under the control of the engineer.
3. A guard or several guards, if necessary, should be available to see that the engineering and assaying equipmer function without hampering, also t guard accumulated concentrates an materials in transit.
4. A geologist and surveyor should b assigned to the engineer as required.
5. A regional geologist should be a thorized to operate independently in o der to supplement the engineerin phases of inspection.

The engineer in charge of the inspe tion of any mine should be charged wi obtaining and verifying all informati concerning the property necessary enable him to determine not only t present production of radioactive mi erals, but the probable productive c pacity of the deposit. The governmer participating in the control or the ma agements of individual properties sh furnish all maps and records necessa to supply the required information.

The preparation of regional geologi maps by the geologist assigned to t inspection personnel, covering the t rain surrounding the producing depos would be of distinct benefit in establi ing the limits of control in a distri Aerial surveys, photographs and ma are to be considered an essential p of such a program. The character a radioactive mineral contest of all ne by rock exposures should be establish It should be the objective of the c trol engineer to know fully as mu about the productive capacity of t mine and surrounding region as the erators.

It is probable that a group of l than 200 of the type just described, tributed among uranium mines n producing, would be adequate to c pletely handle the control situation the known centers of production.

BY-PRODUCT INSPECTION

A few pounds per ton of uranium thorium bearing raw material found a by-product in a mine of small proc tion would be of little significance, in a mine handling many thousands tons of ore a day it might assume gr importance.

The detection of small amounts radioactive elements in the ore from large mine is feasible from the sta point of inspection. The inspection d not need to be continuous, but for

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CONGRESSIONAL NEWS . . .

ENERAL GROVES PRESENTS HIS VIEWS TO SENATE COMMITTEE

Having testified twice before — once open session and once in executive ssion — General Groves appeared for e third time before the Senate Comttee on February 27 to give his views the atomic energy bill. They proved be in opposition to those of President uman and of the Secretaries Wallace, kes, and Patterson.

He began by asserting that "he has more personal interest in proposed islation than any other citizen should ve." Later in the testimony he stated t after "the experiences of the last e months" "it would take very strong ging" to make him accept (the post the administrator). "It would not be ough to tell me we would like to have ." He acknowledged that "during the r, I was both the Administration and Commission," but later described the r-time Military Policy Committee ush, Conant, General Styer, Admiral rnell) as a pattern for the future mic Energy Commission.

n presenting arguments in favor of part-time, nine-men Commission, he d that "that is not a War Department ition at this time." Asked what the r Departments position was, he anred "I don't know what it is. They e sent to the Bureau of the Budget eport, I believe, on the McMahon bill. ave glanced at that report; and I did prepare it." Asked whether Sec'y terson's testimony represents the ofl War Department's position, Gen Groves answered, "yes, until it is nged."

iscussing the qualifications of the nbers of a nine-men Commission, eral Groves said that scientific reentatives should not be nuclear phyts, or come from universities or cols having nuclear physics laboratosince these are not "disinterested." ch men as Presidents Conant of Har and Compton of MIT are autoically barred in my opinion, because r institutions are vitally interested nuclear physics research, although personally would be ideal mem-"

e should get from colleges "such as iams or Amherst men who had ht science and then had become ident of small colleges." He sin out Dr. Bush as a scientist who d be member of the Commission hout interference with other inter-"

the same spirit, General Groves d choose industrial representatives he Commission from companies not ested in atomic energy. "This would any man who was an executive in ral Electric or Westinghouse."

suggested that the Armed Services ld be represented on the Commission by 2-4 men, "either in active service or on the retired list," coming from various branches (Army, Navy, Air Force). He would not consider "a civilian head of the War Department," or "a man who has to go to the Secretary of War or the Chief of Staff to be told how to vote" an appropriate representative for the Services. "I want a man who is not going to forget for a minute that as long as this is the prime military weapon of the country, defense must come first and other things afterwards."

He agreed with Senator Millikin that there is "nothing on the horizon" to make him believe that the military aspect of atomic energy will lose its predominant importance in the next few years. He volunteered in the same breath, the opinion that he "sees nothing that might result in a defense" against the bomb.

General Groves saw no contradiction between his previous statements that "the Army wants to get out of this just as quickly as possible" and his present attitude. He thinks a Committee with a 5:2 or even 5:4 ratio of civilians and military (and an army man as administrator) will be "predominantly civilian." He said "he doesn't recall" having discussed with Gen. Eisenhower the latter's desire for a fully civilian Commission.

He conceded to Sen. Vandenberg that the military representatives on the Commission will have to "sever themselves from the Army" and admitted that this is difficult to reconcile with his suggestion that these representatives should be active officers, serving only part-time on the Commission.

Discussing alternative suggestions for the Commission, General Groves said he "doesn't believe in ex-officio members who are busy heads of departments." Of a three-man full-time Commission, he said "if you have one man with military experience, and one with industrial and one with academic science," that leaves out "more than one military man, who would either have to be air, ground, or sea." Prompted by Sen. Johnson, he added that "it would leave out an Army Engineer."

General Groves then described the way in which he was advised by the Military Policy Committee in the past: "Styer and Purnell could handle the military part of it, Bush and Conant could handle the scientific part. If a chemical problem came up, Conant's advice was always followed." The same was true with Bush's advice on electrical problems. "That is the type of men I would like to see on the Commission."

He conceded that the Policy Committee met only "at irregular intervals—between one and two and one-half months apart," but insisted that they were kept informed and policy decisions "such as building three piles and two separation plants at Hanford" were approved in advance. He recalled that on one occasion he "was overruled by the Policy Committee on a matter of organization."

General Groves then said that "if a bill is adopted which has no military on the commission, the latter should be directed to submit to the Joint Chief of Staff all matters of policy." If they do not concur, these matters should be submitted to the President. The bill should also provide "continuous consultation with the War Department on all matters of security, military research and development, manufacture, storage and use of bombs."

Asked whether basic scientific information should be submitted to the Chief of Staff before release, General Groves answered that policy decisions alone should be so submitted. The Smyth report was written on the basis of one page of rules. "Essentially they were that it could not contain anything that was not already known beforehand, and it gave certain exceptions." These exceptions were things which "men like Hahn or Heisenberg could get the answer once knowing the bomb had gone off," and "things that we knew could not be kept secret over ten minutes after the bomb was off."

General Groves added that, "I read the report. There were some things in there that I couldn't have told whether they met the rules or not, but in each instance a necessary check was made."

General Groves said that he is "90% in favor" of the recommendation of the Tolman Committee for further release of "what is properly termed basic scientific information—things that we learn which have no effect on national defense."

He stated that he knows "of no way" for "this weapon to be inspected internationally" but that he has appointed a committee of nine "which contains three or nearer five who are very much in favor of international control," "to come up with a plan that is scientifically and militarily possible." They are supposed to have the report to us by March 8." It will be made available to the Senate Committee "as soon as I have read it, to see if there is anything that requires further study."

General Groves insisted that he "believes thoroughly in freedom of research," but that "until other nations are willing to join us in reciprocal arrangements, we cannot afford to give

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Sec'y of War Patterson Favors the McMahon Bill - With Amendments

The May-Johnson Bill. Long before the bombs were dropped it was realized that there were unmeasured possibilities in the development of atomic energy for peacetime purposes as well as a war weapon. In May, 1945, Secretary Stimson formed a committee to consider the subject and to recommend legislation. Legislation was drafted under the direction of this committee, the bill being later introduced as the May-Johnson Bill.

The actual draftsmen were Captain Davis, Mr. Marbury, Baltimore lawyer then in the employ of the War Department, and Undersecretary Royall, then a Brigadier General.

The May-Johnson bill provided for a civilian Atomic Energy Commission, to take over and manage all source materials of atomic energy, all stock-piles of materials and all plants. It was provided that the Commission interfere as little as possible with private research. The Commission was given power to adopt the necessary security regulations.

The House Military Affairs Committee held hearings on the bill. It was freely criticized as a measure drafted by the military and intended to perpetuate military control of atomic energy. The House Committee, after adding several amendments further emphasizing freedom of research reported the bill favorably.

The President, since introduction of the May-Johnson bill, has indicated that he is of the opinion that a number of changes should be made in it. The War Department will, of course, advocate such changes in discussion of any detailed legislation.

War Department for International Control. It was realized by the War Department that the means of producing the atomic bomb would not forever remain the exclusive property of the United States. Secretary Stimson was one of the first to recommend a policy of international control of atomic energy, with a view to outlawing its utilization in war and fostering world-wide exchange of information. I have been and still am of the same opinion as Secretary Stimson.

I understand that the Secretary of State, with the aid of some advisors, is now considering what measures should be advocated by our representatives on the Atomic Energy Commission. I don't think the work of that committee has yet been completed. They are still meeting, I think.

For lack of a defined national policy, the organization that was built up during the war is disintegrating.

Senator Millikin: Mr. Secretary, do you appreciate the difficulty in the finding of a national policy until we have some information as to what the international policy may be?

Secretary Patterson: I think we have to go ahead with the adoption of legislation for national policy, bearing in mind the consideration that at all times it must be in step with international policy.

Senator Millikin: Well, you would not say it should be in step with international policy if from a national policy standpoint we considered that international policy did not properly protect our own security?

Secretary Pattersn: I cannot conceive of our being a part to international arrangements that the executive and legislative branches of the Government did not agree with.

The sooner we establish domestic policy and an organization to carry out that policy and gain experience under peacetime conditions in supervising and controlling this field at home, the sooner we can help effectively to lead the way in shaping any international system.

Atomic Energy Must Be Under Civilian Control. Only be a vigorous program of research and application can we hope to advance adequately this new science. At present, the War Department has full control over the entire field. Continuation of this situation is not calculated to advance fully the research and development of peacetime uses of atomic energy, for it is not the primary mission of the War Department to do so.

It has been the policy of the War Department since last September that this project should be turned over to a civilian agency. There has been no disposition whatsoever on the part of the War Department to keep control of the project.

Government Must Own Fissionable Materials and Control Source Materials. The War Department is in accord with the policies outlined by the President in his letter to Senator McMahon:

(1) A civilian commission for control of atomic energy, a three-man group devoting full time to the activity; (2) government ownership of fissionable materials.

Senator Millikin: Do you believe the Government should own material in the ground?

Secretary Patterson: The Government should have full power to acquire the ore in the ground and to explore for it, and own all source materials so mined, as well as fissionable materials.

Senator Millikin: I suggest that would be very impractical. We have had testimony be the Vanadium people, who point out how intimately associated uranium ores are with other ores. If because there happened to be uranium in any ore it came under the threat of Government ownership, we would have a very devastating effect on the development of our mineral resources.

Secretary Patterson: I don't mean automatic ownership, but full power to acquire either by purchase or condemnation the ores in the ground.

Senator Millikin: You would have to buy several of our States and parts of ten or twelve others, because the ores have a trace of uranium.

Secretary Patterson: I think a practical formula for that could be worked out that would exclude matters of the extent that you mention.

I was speaking of the points covered in the President's letter of February

(3) Availability of devices utilizing atomic energy by means of compulsory non-exclusive licenses.

(4) Adequate provision for independent research and development.

(5) Ultimate use of atomic energy for exclusively peaceful ends, by means of safe, effective, international arrangement.

War Department Now for Full-Time Commission

Senator Hart: The May-Johnson b[ill] sets forth one method and now you s[ay] that the War Department advocates [a] three-man group devoting full time [to] the activity. Is it your feeling that t[he] Government can acquire the full-ti[me] services of three men who are fully co[m]petent to be charged with that high[ly] important activity?

Secretary Patterson: I believe so. I[ni]tially we advocated a nine-man board [as] provided in the May-Johnson bill, not [to] be full time people. The matter w[as] discussed in the Office of War Mobili[za]tion with quite a number of execut[ive] agencies represented, and also with [the] President, and the preference of [the] President was for a three-man gro[up] full time. The War Department is [in] accord with the decision. I believe t[hat] the commission would find it advisa[ble] to have an executive manager, call h[im] what you may, to handle the administ[ra]tive matters.

Favors Civilian Control Independently of World Political Situation.

Senator Millikin: Am I correct in [as]suming, Mr. Secretary, that your [re]commendation that the matter be tu[rn]ed over to a civilian commission is [...]

ised on whether Congress reaches the nclusion that the world is really stured for peace?

Secretary Patterson: I think that the velopment of it should be handled as entity, and that the military aspects it should be handled as an entity, and at the military aspects of it can per- ctly well be taken care of by virtue provisions in your Act insuring that e military development be carried on the commission in close co-opera- on with the armed forces.

Senator Millikin: As to the civilian efulness of it, we have had testimony at divides the usefulness in roughly o categories, one for power, and the her for medicinal purposes. But we ed not push forward in those fields. uggest, as long as the overriding con- leration has to do with the energy as military weapon, could we not lock e whole thing up, if security required for a year or two years without da- ging our peace time life in any ma- ial respect?

Secretary Patterson: I do not think it necessary at all that the national de- nse would suffer by the turning over that to a civilian agency under pro- r safeguards.

The Chairman: Does it occur to you t the fact that we might turn this r to a civilian commission would in elf have anything to do with "postur- the world for peace?"

Secretary Patterson: Yes, it might. I nk the turning over of this project a new civilian agency is in line with r national policy to promote world ce.

The Chairman: I believe there is hard- any weapon of war that doesn't find basis now in electricity. There might some argument that all electricity the country should be turned over to War Department for its safekeep- .

Senator Millikin: I think the Chair- n's question to you, Mr. Secretary, ries clearly a theory that we can peace by gestures; that we can get ce by giving a civilian aspect to our st powerful weapon.

suggest that if that is a useful gest- , then we cannot escape making the e gesture as to our lesser weapons, vit, the Navy, and the Army, and Air Force.

Secretary Paterson: I hope that the is not distant when international trols for elimination of atomic pons as instruments of war, to- her with effective safeguards to in- e compliance by all nations, can be ised and put into operation, under pices of the United Nations. In the rval we are faced with the fact that atomic bomb is the most potent pon of war yet devised by man.

ny Should Participate Military Applications

1717 contains a recognition of the tary aspect of atomic power. Section rovides that the commission shall do arch and development in the military applications, shall have custody of all atomic bombs, and may produce them in the future to the extent directed by the President.

The War Department cannot subscribe to these provisions which virtually exclude the armed services from all phases of military application of atomic energy. The Army and Navy would be utter strangers to what was going on, although they might be called on to operate the weapons so developed.

The War and Navy Departments are charged with responsibility for the national defense. Unless it is proposed to relieve them of this responsibility, provision should be made for their activity, in conjunction with the commission, in the military part of this field. The War Department will submit specific provisions along this line.

Wants Army Custody of Atomic Bombs. The War Department is also concerned about the provision that the Commission is to have custody of all atomic bombs. The War Department urges that the stock of atomic bomb components should remain in the hands of the military forces.

It is of great importance that as much information as can be made available without prejudice to the national safety should be freely circulated. At the same time it is of vital importance that adequate means be provided for holding information secure where release would be prejudicial to the national safety. In determining what information would endanger national safety, common prudence requires that the armed forces should be consulted. The announced policy of the United States is that the technical secrets of atomic bomb manufacture should be held secure. Security provisions of domestic legislation should reflect this policy.

Believes Espionage Act Inadequate

S. 1717 places reliance on the Espionage Act. The Espionage Act is inadequate. It does not prohibit the transmission of military information even by government employees unless subversive intent can be shown; nor does it prohibit the communication of information of military value that is developed by private persons.

The Chairman: What law protects developments in radar or bombsights?

Secretary Patterson: The Espionage Act is doubtless the Act that is most relevant, but careful reading of the Espionage Act shows that not all the communications of information of importance to the national defense is covered by it. In time of actual war of course there is a fairly broad provision in the Espionage Act, the concluding provision. However, it is hard to find anywhere in the Espionage Act anything dealing with disclosure of information unless it is with actual intent or reason to believe that it will injure the nation because certainly the first five clauses of it are all qualified with the existence of that intent.

The Chairman: Wouldn't it be better to try to design a general statute to cover all military information rather than to work it out on this particular problem? Wouldn't it be well, Mr. Secretary, if the War Department was to recommend to the Congress amendments to the Espionage Act?

Secretary Patterson: I would put it right in the measure itself, and would give the commission authority to adopt regulations in line with the general policy of having the freest possible circulation of information.

Senator Austin: I think the Secretary's attitude in the matter is justified by the history of attempts to tighten up the Espionage Act.

Secretary Patterson: As I read the Espionage Act, each division of it deals with a specific case. They are a series of specific provisions against particular things, and for most of them you have to prove the intent.

The Chairman: Which is a pretty sound protection of the Anglo-Saxon system.

Secretary Patterson: I quite agree, Senator. It is all a question of how important you see it.

Take the technique of the actual bomb manufacture, for instance. The commission ought to have the fullest power to protect that information. If anybody just saw fit to exercise free speach about it, is it thought for a minute that that should be done?

The Chairman: Now aren't there other fields in which it is just as important?

Secretary Patterson: No, sir; not as important as this weapon that I know of.

Basic scientific information should be freely disseminated but the commission should be empowered to define what is included in this concept, having due regard for the national interest.

The Chairman: You mean the commission should decide what is basic scientific information?

Secretary Patterson: I think they should outline the boundaries of it.

The Chairman: Do you advocate any veto power by the military as to what constitutes basic scientific information?

Secretary Patterson: No, sir.

The Chairman: Do you contemplate that the commission, before releasing basic scientific information, should submit it to the War Department for its review?

Secretary Patterson: I see no harm whatsoever in having consultation before that, but the matter should be in the power of the Commission, subject to approval by the President.

I think the Commission should, of course, consult on a matter of that sort with the Army and Navy to get their ideas, but not to be bound, however, by what they say.

The part about this bill that concerns me is the exclusion from every consultation of the people who are responsible

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CONGRESSIONAL NEWS

Sec'y Patterson for McMahon Bill -- With Amendments

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for the national defense—even from consultation.

The Chairman: There is a Division of Military Application, Mr. Secretary.

Secretary Patterson: But it doesn't mention anywhere any contact with the War Department or Navy Department. There is nothing there to suggest that the Division would have any speaking acquaintance with anyone in the War Department or Navy Department.

I appreciate the concern that is felt by people in excessive security regulations, and you have got the two interests that I think anyone who studies it must concede exists: A policy of the freest dissemination possible in order to exploit any possibilities of this power, and, at the same time, certain facts that must be protected by security regulations. I know of no better way than to vest it in the commission.

The Chairman: Do you think that there is any possibility that this country might weaken its national defense if it set up air tight secrecy restrictions on the dissemination of scientific information?

Secretary Patterson: I can imagine no useful purpose to be served by revelation of the technique of bomb manufacture. I can imagine very harmful effects from it, extremely harmful, and I can imagine nothing useful.

The Chairman: But I can also see, Mr. Secretary, considerable harm that might come to scientific progress by a continuation of the Manhattan District's philosophy as to the security.

I can see, from talking with the scientists, many of them who furnished the essential ideas under which this as made, that they will not continue under the same kind of secrecy restrictions as they did in wartime.

Secretary Patterson: Of course, I am interested in their views on it. They are of value.

Conclusions

In conclusion, the War Department stands with those who desire the establishment of a sound and effective national policy for the development of atomic energy geared to the highest interests of the nation and of the world. Knowledge in this field must be greatly expanded, and to this end the War Department favors minimum interference with independent fundamental research consistent with requirements of national safety. We are convinced, however, that until such time as international arrangements and safeguards to make this goal effective have been worked out, stage by stage, legislation relative to atomic energy should make provision that the War and Navy Departments be consulted and take part in those phases of atomic energy relating to military application. We are also convinced that the power of the commission to adopt adequate regulations for protection of information vital to the national defense should be stated in terms that admit of no doubt or debate. We urge that S. 1717 be amended to cover these essential matters.

SECRECY IN SCIENCE

L. N. Ridenour

(Continued from page 3)
such as that we are in today, even in the war to which such an armaments race is likely to lead us, how do we benefit by withholding the results of such investigations in medical fields?

It is my opinion that all of the atomic energy control bills so far presented go much too far in imposing restriction. There would be little purpose served by full publication of instructions for the manufacture of an atomic bomb, and I believe that it is wise to restrict the publication of information concerning finished military devices. On the other hand, there is no benefit to us, and there can be very serious harm, in restricting the performance of experiments or the publication of results in any field of basic science, nuclear physics included. The definition of "basic scientific information" in S-1717 is too narrow. It is important to publish not only the end results of scientific work, but a detailed description of how they were obtained. It is only this practice which distinguishes modern science from medieval alchemy.

We can make an analogy with the way other weapons are handled. The design of guns is kept confidential; yet the metallurgy of steel is dealt with in the usual way. Military aircraft are designed in secret; yet the aerodynamic principles on which they are based, and even techniques such as flush riveting, are freely published and available to all. It is thus that scientific and engineering progress is made.

Advocates of secrecy in science feel that it will advance our national security and strengthen our national defense, else they would not advocate it. All of the evidence available to me shows that scientific discovery and engineering development cannot flourish fully except under conditions which allow all competent men to be fully informed, and thus able to contribute to progress. We shall weaken, not strengthen, our national defense by any restrictive measures on performance or on publication in scientific fields.

GEN. GROVES STATES HIS VIEWS

(Continued from page 5)
any essential part of information we have until such time as we are assured that it will not be used against us."

Asked by Sen. McMahon whether security regulations, whose violation would be criminal acts, should have the approval of the President, General Groves replied that—"I would just hate to see anything more thrown on the President than he has to have"—to which Sen. McMahon retorted that he'd rather try to remove from the President some matters "which do not affect the life and liberty of our citizens."

At this point, Sen. Millikin accused General Groves of advocating turning over the control of a most important military weapon to a civilian commission. He asked General Groves whether such a commission should have the right to tell the military forces "how many bomb to make, how to make them, where to keep them or what to do with them." General Groves answered that all policy decisions should be confirmed by the Chiefs of Staff.

Turning from the Commission to the Administrator, General Groves said this was "the primary place where active officers are apt to be used." Describing the duties of the Administrator, he classified them as (a) running the existing organization and (b) handling outside contacts. For example, if a university wants enriched material, he would investigate whether they meet our policy requirements on security and whether they will really put some efforts into this thing and not just to say, 'We, too, have a department in nuclear physics.' Asked by Sen. Hickenlooper whether such screening would be compatible with freedom of research, Gen. Groves answered that "before the commission gives them material, they should meet requirements that will ensure the best interest of the United States."

He also said that "if someone should achieve getting atomic energy out of a common element, I don't believe that should be published." He described Argonne Laboratory as an example of a place which "will be put on the basis of free and open research," but where "if we decide that certain work should be secret, we will have the right to ask the man to continue on a secret basis or abandon the work and turn it over to us." He insisted that "despite what you read in the papers" "the Army has cooperation and good feeling in all the laboratories."

Answering a question of Sen. Hickenlooper, Gen. Groves said that compartmentalization "decreases perhaps in some instance the ability of a scientist to do his best," but "in this case the military security overrides that" and "he has got to get along without some knowledge or to find it in some other way."

oses of confirmation should be repeat- at irregular periods.

Should any large mine prove of im- ortance as a source of radioactive ma- rial it would become subject to the pe of inspection provided for produc- g mines.

ETECTION OF NEW DISCOVERIES

The goal of a program of regional in- ection is to obtain prompt informa- on concerning the location and magni- de of any new uranium or thorium posit as soon as possible after dis- very. When a discovery offers pro- se of becoming a mine an inspection ogram would be started.

The methods that may be utilized uld provide rigorous inspection with comparatively small personnel. If ch methods are studied with care and plied on a world wide scale, the ac- ptance of the program by the coun- es most concerned would be a strong lication of cooperation. Should any tion accept such a program yet later dertake a campaign of obstruction it unlikely that such a policy would es- pe notice.

A nation would need to be willing to ve representatives of an outside in- national organization go from place place, visit mines as requested and ry on tests for uranium and thorium where from the largest mine to the st remote prospect. Portions of files government agencies and private npanies applying to sources of raw terials should be available to proper- authorized inspectors.

nspection would be greatly aided if nmercial incentive can be established such a way that prospectors find it re profitable to dispose of radioac- minerals to the international or- ization than elsewhere.

n regions where all title to mineral osits is vested in the state the pos- lity of establishing incentive aid will end upon state agreements. This ld probably mean that within the nain of prospecting for uranium and rium the authority of the interna- al commission would need to be ater than that of the state itself. s could become a major problem in otiations with highly nationalized es.

nspection may be greatly simplified he only organization authorized to chase uranium and thorium ores is nternational inspection organization. nder such an arrangement all oper- s producing uranium or thorium would presumably do so under li- se of the United Nations Organiza-

TECTION OF EVASION

ne of the problems that frequently es in any discussion of inspection is of presumed active or passive ob- ction. However, it would seem like- ly, that, having granted permission for inspectors to visit all mines, to look at any geological occurrence of interest, to require regular reports on all discoveries, to make maps, to conduct aerial surveys where necessary for purposes of inspection, to conduct an aerial reconnaissance, and to buy and sell all uranium and thorium ores, little actual opportunity would remain for obstruction. If obstruction did exist, it would hardly remain unknown for long.

Aerial surveys now make possible the rapid assembly of data covering the location of mineral deposits for large sections of the earth's surface. Mines are easily visible from the air and the roads leading away from mines are usually well travelled. Under normal circumstances a combination of aerial reconnaissance and surface exploration should reveal the presence of any mine of consequence.

One of the points that frequently arises in considering the problem of locating new discoveries is the possibility that a country which wishes to evade inspection, will find a new deposit of uranium or thorium in some remote locality, and will conceal a new mine through the use of camouflage.

Through the cooperation of Col. Homer St. Gaudens, who was active in camouflage work during the war, the Committee learned that the detection of camouflage has reached an advanced state of development not ordinarily appreciated.

The key element in the detection of camouflage is a suspicion that in some area evasion is being attempted. If suspicion exists, although the area that must be inspected to find a hidden mine may cover as much as a hundred square miles, it is possible to accomplish detection. The most effective method that can be employed in this detection is aerial photography.

In peace time the mere existence of a camouflage project would arouse suspicion. If the photographic plane is able to fly low, to circle and to photograph at will detection from the air becomes highly efficient.

Through the war the Military Geology Unit of the United States Geological Survey cooperated with the army in the study of terrain in enemy country. Maps of enemy country showing the distribution of the types of rock exposed at the surface, and many geological features were prepared.

It would seem likely that the technique utilized by the Military Geology Unit could be applied to advantage as one phase of international inspection.

The total personnel that would be required for the detection of new discoveries depends upon the privileges and authority of the inspecting organization. However, where types of inspection, which might form a part of the general inspection program have been attempted, the numbers involved have been comparatively small. It is easily possible that a group totaling not more than several hundred might be able to develop and successfully apply an international inspection system.

SUGGESTED PROGRAM

The first phase in inaugurating an inspection program would be an international review of all published data and all confidential files on the distribution and amounts of raw materials. Each country should be required to supply all pertinent data.

The second phase would involve:

(a) visits to all producing mines by an international commission.

(b) an international survey of potentially productive areas revealed under phase one.

(c) confirmation of data on raw materials previously produced. This would be assentially an inventory of materials above ground.

It is assumed that the two phases would be followed by the inauguration of an inspection program to apply both to raw materials and manufacturing. Inspection should be established on a working basis before those nations holding the technical secrets of the atomic bomb would be expected to make complete revelation.

CONCLUSION

The Committee concludes that technical control of raw materials is sufficiently feasible to justify a serious attempt to establish a control system. The system established should include inspection at known mines, by-product inspection, and a detection program for new discoveries.

Inspection at known mines could be carried on with a comparatively small personnel and could be made highly effective. By-product inspection would need to be established on a periodic basis in order to bring all mines with a small radioactive by-product within the inspection network. The detection of new discoveries provides the most troublesome problem of all raw materials inspection. It could become effective if supported by a formidable series of rights and privileges.

The most important feature in inspection is to make certain that every device, not only technical, but economic and political as well, shall be provided to furnish the foundation upon which inspection can operate. Granted such a foundation, the Committee feels that a competent technical organization, with adequate field facilities and suitable laboratories, could establish a highly efficient world wide raw materials inspection for uranium and thorium. The personnel involved would not be too large, and the facilities required would be modest, in contrast to the importance of the undertaking.

SCIENTISTS IN WAR AND PEACE . . .

Edward Teller

The atomic bomb is in its earliest infancy and even a moderate amount of work may improve it considerably. Future bombs may become less expensive, may be easier to handle and they may have a much greater destructive power.

I do not know whether international developments will make further work on atomic bombs necessary. I share the hope that the atomic bomb together with other weapons of aggression will be eliminated. But if it should be necessary for us to proceed with the development of the atomic bomb it must be pointed out that, under present conditions, this is hardly possible.

Among the peace-time applications, extraction of useful power from chain reacting structures will have the greatest economic significance. One must not expect any profound effects on our economic life, but specific applications may be important. One is the production of energy in places which cannot now be cheaply supplied. Another is construction of smaller energy-producing units which will keep working for a very long period of time. Progress towards all these ends has been in the recent past slow.

Use of radio-elements which are by-products of atomic power plants will have an extremely great influence in science, particularly in medical science. It will lead to a better understanding of live organisms, and cannot fail in the end to be an instrument in saving many human lives. Progress in this direction has been so far practically negligible. Distribution of these elements would disclose no further secret and would result in no real danger since in small quantities these by-products are harmless. The only reason why the by-products have not been so far distributed and used is due to the inertia of the administrative apparatus. I believe that these materials should be made available not only to scientists in this country but to scientists throughout the world.

Scientific use of by-products will probably not be long delayed. All other phases of work on atomic power present a much more serious problem. This is due to the fact that scientists are returning to their academic work and the great majority of them has stopped being actively interested in further developments of a practical nature. During the war-time emergency everybody knew that a job of extreme importance had to be accomplished. Now that the immediate danger has passed most scientists decline to do further work on war projects. There are several reasons for this.

Scientists are men who have chosen as their work the free investigation of nature. For this freedom they have sacrificed the expectation of a greater income which industrial or commercial jobs offer. They will not sacrifice this freedom except for the most compelling reasons.

In times of peace many feel an understandable reluctance to work on weapons of destruction.

With the success of the atomic bomb a number of routine operations have become part of the program. In Los Alamos, these routine operations threaten to crowd out research and development. Under such conditions it is extremely difficult to secure the cooperation of scientific personnel.

The development of atomic power and the production of the atomic bomb were possible only because individual scientists were willing to take the initiative and to assume responsibility. According to the nature of the organization in which we were working, and which continues to be in force, such individual actions were not encouraged and often met with resistance. Since the emergency has passed, few scientists are willing to bear such a burden.

What can be done to induce a reasonable number of scientists to work on the further development of atomic power?

First, it is important that legislation should be passed to make long-term planning possible and thus remove some of the handicaps. **But wrong kind of legislation will merely cause the present stagnant conditions to continue.**

It must be clear that no kind of pressure can bring about real progress in science. It is impossible to force a person to be inventive and resourceful.

Mere financial inducement will not suffice either, and congress can not insure progress by simply appropriating great sums of money. One of my young friends has recently accepted a stipend of $150 per month because this stipend permits him to continue his studies and his research. In doing so, he turned down a job with a salary almost six times larger. A certain amount of money will of course be necessary. But other conditions are not less important.

One of these is the removal of certain secrecy regulations. Purely scientific data; i. e., facts concerning natural phenomona, must not be kept secret. If such secrecy is continued it will warp the entire research activity of any man who is involved in work on atomic power. He either has to sever relations with the scientific world not involved in the development of atomic power or he has to acquire a split personality, remembering in certain parts of his work only certain parts of the information available to him.

Furthermore, scientific facts cannot be kept secret for any length of time. If we attempt to keep scientific facts secret, it will certainly hinder us, but will hardly interfere with the work of a potential competitor.

The only secrets which can remain effective for a reasonable length of time are technical details of construction and industrial know-how. Indeed, these things cannot be easily communicated except by actual collaboration. As an example, I may mention the construction of cyclotrons. In spite of the fact that full details have been published, everyone had the greatest difficulties in reproducing these instruments except those men who had a chance to learn directly from the original inventors.

Another part of security regulations which will impede progress is compartmentalization. During the work on the atomic bomb, an attempt was made to give each person only so much information as he needed to perform his specific task. Thus the field of vision of each individual was artificially narrowed down. He could not use his full imagination. He could not be fully useful. One great drawback in this system is that in scientific work no person can judge what information another man will need. Scientific work is a continual search for surprises. It can be taught, but it cannot be planned or directed. Compartmentalization is the principle that your right hand not know what your left hand is doing. In the long run this principle makes effective research impossible.

I believe that even if some secrec
must be maintained, it should be re
tricted to a few technical details. Se
recy regulations should be in a larg
measure entrusted to the people wh
themselves engage in the work. An
finally, everyone who is judged to b
capable of original contributions an
who is working on the technical deve
opment of atomic power should b
authorized to receive information in th
entire field. One should withold inform
tion from a scientific worker only if or
has reason not to trust him. In th
case, of course, he should be given n
information whatsoever.

The Bills of Senator McMahon ar
Senator Ball contain provisions to e
empt scientific information from se
recy. It would be a further great in
provement if the law would contain
provision against compartmentalizati
of technical information.

Perhaps the most important requi
ment for successful scientific work
the encouragement of individual init
tive. In organizing work on atom
power there exists the grave danger
too much planning, of too great centr
ization. Thus a mistaken idea, a sing
scientific prejudice in the minds of t
planners may render the whole progra
barren. Such vigorous planning w
furthermore, repel the best scienti
talent.

This danger cannot be avoided by go
legislation but only by a reasonable
ministration of the law. But legislati
may act to prevent overcentralizati
by earmarking a yearly sum for sm
projects, carried out at universiti
These projects should not be under t

(Continued on next page)

C.C. Rally Backs Civilian Control of Atomic Energy

A mass rally was held in Orchestra all on February 25 under the auspicies the Independent Citizens' Committee the Arts, Sciences and Professions. drew a capacity audience of over 2500, hich unanimously passed a resolution dorsing the McMahon bill.

Harold Urey pointed out that it is imssible to expect the Army to undernd that freedom of thought is the eblood of science.

Harlow Shapley talked about his it to Soviet Russia last summer. "My ks with Russian scientists made me lize more imperatively than ever the portance of international cooperation ve are to solve the problem of war and atomic bomb. Russian scientists, like nerican scientists, recognize that one the problems which must be solved in near future is the enrichment of innational relationships."

We in the United States, seem to be ahead in most scientific fields. Our dership is commonly recognized by ssian scientists. They frankly plan follow our lead—eventually to equal successes and progress and to profrom our mistakes.

do not intend to imply that the Rus- scientists are trailing all along the . In the fields of plant physiology ecology, the Russians have done t-class work. The modern science of soil was originated in Russia. The lov Institute has long carried on t revealing studies of the nervous em. Current Russian mathematics ds very high and in some departts is not excelled in the world.

Vith their two great observatories royed completely and some others y damaged, it is not surprising that two or three American observatoreach have more equipment, and pos- more active personnel than you find in all of Russia at this time. this inequality is temporary.

century ago, the observatory at kova near Leningrad, was the astroical capital of the world. When in ngrad, we visited the sad site of the kova Observatory. That hilltop now tragic mess. Only some battered s are standing—precariously.

you can visualize that awful waste v on Poulkova Hill, the wreckage of tific equipment, gathered and used eseach that has enriched your lives mine as well as that of the Russ-—and then—in your mind's eye, ex- that war waste over a large area, will have a dim impression of the station of atomic bombing.

hould man and all that man has acolished wither in the atomic fires because we have no adroitness in national relations?

he alternative is for the policyers of the great nations to recognize the planet is too small for compet-ationalities. This is not a matter of san policies. This is an issue for endent citizens—for independent ers—and the time is now."

Senator Tobey was unable to attend. Following are quotations from his prepared speech:

"All of us realize that the United Nations Organization, as adopted, is not just what we would have liked, but it was the best we could get. We recognize the gross weakness that exists in this organization by virtue of the veto power. We aim to correct this by amendment, as soon as possible.

"No nation has heretofore been willing to give up sufficient of its national sovereignty to set up World Government. The first change in this attitude came in Eden's recent statement, supplement by Bevin's plea for World Government.

"Perhaps you feel as I do that the Assembly itself should be the dominating body—the Assembly which gives representation to small nations as well as great.

"There has never been a time when the Congress has had more complicated problems to face, both domestic and international. But suddenly, with the dropping of the first atomic bomb, there was presented a problem transcending anything in the history of the world.

"Once let other nations be convinced that we have adopted a policy of secretely developing nuclear science for military purposes, and that would leave no alternative but to follow suit as quickly as possible, and we would have a diplomacy of fear ruling international matters."

The closing speaker was Congresswoman **Helen Gahagan Douglas.**

"Traveling in and out of Washington at the present time is a group of serious, thoughtful men. They are not subsidized by any political or economic group. And, strangely enough, they are not seeking anything individually for themselves.

"Who are these people? The foremost scientists of the day.

"What are they trying to do? Trying to save us from ourselves!

"Are we going to listen to the only men who have the facts? Or are we going to lull ourselves into eternal sleep with soothing syrup passed out by local, national, or international medicine men?"

In introducing the resolution to urge the passage of the McMahon bill, **Dr. Gustavson** said:

"The appalling lethargy which has overtaken too many people on the problem of world peace is the most critical condition we have to fight today.

"The McMahon Bill is based on the assumption that we will have international understanding on atomic energy. It protects everything of a military character but allows research to continue.

"For these reasons, scientists believe the McMahon Bill to be the child of careful thought and determination for the future of mankind without wars, whereas the May-Johnson Bill is based on the notion that there is no escape from wars."

SCIENTISTS IN WAR AND PEACE

(Continued from page 10)

direction of the central administration of atomic power. They should be responsible to the faculties of the respective universities. Their success should be judged after three or five years. If even one percent of the money spent on atomic power would be set aside for such long-range investments, we could be assured of valuable returns.

To obtain a picture of the way in which scientists could most effectively participate in future work on atomic power, the problem should be considered under five headings:

1) **Work on general scientific background and on education.** Scientists are most eager to engage in this work. If the traditional freedom of research is preserved and if some financial aid is given, this type of work will flourish.
2) **Work on technical peace-time developments.** One should attempt to carry out a considerable part of such work at universities but only under the condition that the work need not be kept secret. In this way universities will remain institutions of free learning and enquiry.
3) **Development of weapons.** If this activity is judged necessary, it should be carried out in the most effective way. This means that secrecy should be reduced to a minimum. As much as possible of the work not subject to secrecy should also be carried out at universities. The rest must be done at special laboratories with participation of full-time and part-time scientists. To secure the necessary scientific personnel for this work in peacetime will be difficult. The special laboratories must have, therefore, an exceptionally wise and liberal leadership.
4) **Production of weapons.** This work will never attract scientists and in the long run scientists are not needed in this work. The work should be transferred to the armed forces and placed under the direct authority of the President of the United States.
5) **Testing of weapons.** This activity is of great interest to the armed forces and for the scientists as well. An atomic bomb may be regarded as a scientific tool. It allows us to find out facts of nature which cannot be found out in any other way. These tests cannot be effectively performed either by the armed forces alone or by the scientists alone. Tests should be planned mainly by scientists, but in the actual execution the armed forces should participate to the greatest possible extent.

"One World or None" To Be Issued Soon

Publication date for ONE WORLD OR NONE, a Report to the Public on the Full Meaning of the Atomic Bomb, has been set for March 18 by Whittlesey House, a division of the McGraw Hill Book Company. Whittlesey House considers the book its most important in its 15 years of publishing and in order to make the book available to the widest possible market has departed from a long established policy and will issue the book in a paper binding at $1.00. A cloth bound edition at $2.00 will follow later.

Chapters have been written by authorities from the project and from political and military fields. Following is a list of the chapter titles with the authors:

Introduction ....Arthur H. Compton
Foreword: Science and Civilization ....Niels Bohr
Hiroshima & New York--Philip Morrison
Atomic Energy in the Stars........ ....Harlow Shapley
Roots of the Atomic Age....E. P. Wigner
The New Power ....Gale Young
The New Weapon....J. R. Oppenheimer
Air Force in the Atomic Age........ Gen. H. H. Arnold
There is No Defense....Louis N. Ridenour
Bomb in the Basement........E. U. Condon
Other Countries Can do It........ ....Frederick Seitz and Hans Bethe
An Atomic Armaments Race and Its Alternatives ....Irving Langmuir
What It All Adds Up To............H. C. Urey
Can We Avert An Arms Race by on Inspection System...............Leo Szilard
The International Control of Atomic Energy ....Walter Lippmann
The Way Out ....Albert Einstein
Survival is at Stake....Federation of American (Atomic) Scientists

The book was edited by Dexter Masters of the McGraw Hill Company and Katharine Way of the Metallurgical Laboratory. The first printing will be 100,000 copies. It is hoped, of course, that it will have a very wide distribution and be a real help in bringing to the public not only the facts but also implications of the bomb and that it will help to arouse the feeling that wide discussion of our possible national and international policies is needed urgently.

SENATE COMMITTEE PREPARES BILL

(Continued from page 1)

kept secret; this line he wants drawn by the civilian commission.

The amendments which Patterson suggested, would give the Armed Forces the right to conduct military research in the field of atomic power, to have the custody of atomic bombs and to be consulted on security regulations.

In addition to the McMahon bill and the suggestions of Patterson, the Senate Committee takes with it, into its executive session, the knowledge of strained relations with Russia and consequent scepticism as to the success of international cooperation; ugly rumors of impending wars; real and fabricated spy-scares and the resultant poisonous fog of suspicion.

Can we hope that in this atmosphere, the Senate Committee will write a wise and enlightened bill, looking forward to international cooperation and peaceful development of atomic energy? Is the Committee likely to realize, under these unhappy conditions, that even in the case of an armament race, the best hope for this country lies in maximum development of creative research, and not in its stifling by military rule, secrecy and compartmentalization?

After spending several days in executive session, the Committee re-emerged to listen to a last admonition by General Groves. In opposition to the Commander-in-Chief, and to the Secretary of War, General Groves presented his personal views. The program of military dictatorship over science, which lay concealed in the May-Johnson bill, was boldly outlined by him. He suggested a part-time, nine-man Atomic Energy Commission, containing up to four military men—a Commission from which all competent scientists are to be barred because they are "not disinterested." He would like to see an officer on active duty as the Administrator. As a desirable pattern for the relation between the commission and the administrator he outlined the war-time relation between himself and the Military Policy Committee —in which, according to his own words, "he was himself both the Commissioner and Administration."

This is a program to drive away the best scientists in the country—who wi[ll] feel that their efforts will be wasted b[y] working under these conditions. The[y] will choose other fields to work in—n[ot] for reasons of personal convenience b[ut] because they will be certain that in th[is] way they can make a greater contrib[u]tion to the progress of science and n[a]tional welfare.

To the military mind, one scienti[st] may be as good as another; if one leav[es] he can be replaced by another one. Th[is] is the spirit in which Hitler let the be[st] German scientists leave the country. H[e] thought that he could find adequate r[e]placement among servile nonentiti[es] with party membership cards. This [is] the spirit which dryed out military r[e]search in this country between the tw[o] World Wars.

The decision now before the Sena[te] Committee, and soon before the Co[n]gress as a whole, is of tremendous i[m]port. Will the Congress, in despair ov[er] the momentary—and perhaps passing international troubles, enact legislati[on] which will create, in the tissue of o[ur] public life, a malignant tumor of irr[es]ponsible military rule; which will sti[fle] science in the name of a futile 'securit[y]' create a "Maginot line" of a stock [of] atomic bombs, and start the whole wo[rld] on the road to disaster?

"Look" Publishes Pictorial Summary of Atomic Bomb

Look, March 5, Editorial Staff: "Your Last Chance to Avoid Atomic Destriction." A fifteen-page pictorial article—depicting destruction which a bomb will cause in an American city, the folly of a militaristic "solution" of conquering and policing the world, the horror of living in a world where atomic bombs may fall at any hour, the devaluation of property and desolation caused by dispersal of cities. Direct appeal to teachers, clergymen, salesmen, real estate men, newspapermen, others to organize action among their professional groups for enlightenment on the dangers threatening them specifically, and organized action for the prevention of an atomic war.

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LETIN of the
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ilitary or Civilian Control Of Atomic Energy?

The controversy "should atomic energy in America be under military or civilian trol" has been brought to a showdown in the Senate Special Committee on Atomic rgy.

On the extreme militaristic side, there is Senator Eugene D. Millikin of Colorado believes that even General Groves favors too much civilian influence. But ustice to General Groves, his scheme of an Atomic Energy Commission containing military among its nine members with an active officer as administrator, can be ed upon to bring about complete military control.

The argument in favor of leaving research and development of atomic energy in hands of the military goes as follows: "The atomic bomb is the most powerful pon in existence. The applications of atomic energy to peacetime industrial cesses can be postponed without endangering our national economy. With the world tical situation as it is, we must give first priority to the military problem, and this best be achieved by leaving the control of atomic energy in the hands of the military. will ensure the maximum production of atomic weapons in America, prevent leak-of our atomic bomb secrets to other nations, and thus delay the atomic rearmament ur potential enemies."

This argument is fallacious. In the first place, it is not true that the world political ation is independent of our policy on atomic energy; in the second place, it is not that the best way to ensure our continuous superiority in atomic armaments is to the military in full control of research on atomic energy.

For the present state of mutual suspicion and fear between the wartime Allies is considerable degree the result of our failure to provide a clear lead in dealing with nic energy. The international repercussions of the establishment of a permanent tary control over atomic energy in America may well be disastrous for the cause of e. Some politicians may view this step merely as a warning to the Russians, as dditional show of toughness in dealings with the Soviet Union. However, putting a on the statute book will be taken by the world, not as a tactical step, but as a part long-range policy. International tensions come and go; but policies which have tallized out in the form of laws or treaties remain. Permanent military control of nic energy in America will signify to the world that America is basing its long-range cies on the assumption that a new war is inevitable, and this will help to make it itable.

While making the prevention of a new war more difficult, military control will not re our continued advantage over the rest of the world in atomic armaments (and cientific war potential in general). The Army will inevitably put emphasis not on tive research, but on building the largest number of atomic bombs of the existing and protecting the secrecy of the present processes by strict security regulations, other police methods.

If we expect a war this year or next year, this unrealistic attempt to perpetuate omentary advantage will be of little avail, but will do no particular harm. But nd this short term, this policy bodes ill for our security (as far as security can at e obtained by maximum striking power). It is already depriving the atomic bomb ratories of their most valuable brainpower. The really good scientists feel that effort will be wasted if they are forced to work under the conditions of secrecy compartmentalization, without the benefit of free exchange of ideas. Research ratories which are run in this way will soon lapse into routine work. The importance crets that can be safeguarded by military supervision of science is widely exagger- in the public mind. As repeatedly pointed out by informed scientists, and confirmed ngineering experts who have participated in the building of our atomic bomb plants, delusion that we are safely protected by a secret stock of atomic bombs and an eric knowledge, which we share with nobody, may easily become a "scientific inot line."

Secrecy regulations, which military mentality is likely to force upon fundamental scientific research, will cause a paralysis of scientific progress. This paralysis will spread from governmental atomic bomb laboratories to all laboratories working in the nuclear field. The necessity may arise of establishing secret courses in our universities, leaving the majority of students in ignorance of basic facts of their science. With nuclear physics as an opening wedge, the same disintegration may permeate the fields of bacteriology, medicine, and other sciences all of which may be used in the next total war.

Since public opinion does not distinguish between science on the one hand, and technology (in which "secret processes" are common), on the other hand, it is likely to consider the opposition of scientists to military rule and compartmentalization only as a selfish fight for a comfortable way of life, or as the defense of certain liberal ideals, which have to be scuttled in the face of the "hard facts of life." What may be scuttled in the process, is America's leadership in scientific and technological developments, decisive for its future position in the world.

But, it may be argued, the Senate Committee did not follow General Groves and Senator Millikin. By a vote of 10:1, it has accepted on March 12 the "compromise" proposal of Senator Vandenberg:

"There shall be a Military Liaison Board appointed by the President composed of representatives of the Departments of War and Navy, in such number as the President may determine. The commission shall advise and consult with the board on all atomic energy matters which the board deems to relate to the common defense and security. The board shall have full opportunity to acquaint itself with all matters before the commission.

"The board shall have authority to make written recommendations to the commission from time to time as it may deem appropriate. If the board at any time concludes that any action or proposed action of the commission, or failure to act by the commission, is inimical to the common defense and security, the board may appeal

(Continued on last page)

Can Air Or Water Be Exploded? . . . . H. A. Bethe

There has been much public discussion as to whether or not atomic bombs can start a nuclear chain reaction in the atmosphere. Similarly, since the planning of the Navy tests, many thoughtful scientists have expressed concern about the possibility of the chain reaction in water. And at least one fiction story appeared which told in an impressive way of the end of the earth caused by a chain reaction throughout the solid matter of the earth.

This concern is, of course, very well taken, and it is necessary to examine in great detail the possible dangers of atomic bomb tests before carrying them out. Such considerations can be made with the help of existing nuclear theory without making any assumptions going beyond the range of well explored phenomena. The conclusion from the calculations is that there is no danger of a nuclear explosion in any substance naturally occurring on earth with any of the atomic bombs which have been developed or have been conceived on paper.

The most effective safeguard against unwanted nuclear chain reactions is the fact that all atomic bombs must carry a considerable amount of inert material, including the firing mechanism, the neutron reflector, and other parts which have a total weight many times greater than that of the active material. For this reason, the temperatures which can be transmitted to the material surrounding the bomb are very much lower than the temperatures existing inside the active material. It is well known that all nuclear reactions depend very strongly upon temperature, i.e., on the energy with which the various nuclei are moving against each other. A lowering of the temperature, therefore, means a great reduction of the probability of nuclear reactions.

THE BOMB AND THE STARS

The temperatures which can be produced in the air or water surrounding an atomic bomb of present construction are of the order of 1,000,000°, maybe somewhat more, maybe somewhat less. This is very much lower than the temperatures prevailing at the center of ordinary stars, which are of the order of 20,000,000°. We can, therefore, use the stars for comparison and can be sure that the nuclear reactions in the substance surrounding the atomic bomb will be less frequent than in the stars. Moreover, it is clear that the amount of inert material in the bombs could be reduced appreciably before we would attain in the surrounding material the conditions which prevail in the stars.

In normal stars the most important nuclear reactions are believed to be between protons on one side and carbon or nitrogen nuclei on the other. The reaction between protons and oxygen is less probable by a factor of about 10,000 at stellar temperatures, but even the reaction between protons and carbon is extremely slow, so that it would take several million years for the carbon in the sun to be consumed (if it were not regenerated in the actual stellar reaction cycle). A nuclear reaction which takes millions of years to be completed is certainly very far from being an explosion, at least by a factor 10^{14}. It will also be noted that neither in water nor in air are there large numbers of those nuclei which would cause one of the probable reactions, i.e., carbon and hydrogen, or nitrogen and hydrogen.

Another reaction the theory of which has been developed in detail, is the combination of two protons to form a deuteron with the emission of a positron during the collision. This reaction is simple enough to be treated with some completeness by present theory. It is favored by the fact that the two interacting nuclei have the smallest possible charge and have also a small mass (which facilitates leakage through the potential barrier according to the Gamow theory). On the other hand, the proton-proton reaction is made improbable by the fact that a positron must be emitted during the process in order to conserve the charge. It is well known that all processes involving the emission of negative or positive electrons are exceedingly improbable as measured by nuclear standards. The calculation of the rate of this process shows that in normal stars it is slightly less probable than the reaction between protons and carbon or nitrogen. However, since it involves a relatively small potential barrier, this reaction will fall off less rapidly than others when the temperature is decreased. It is, therefore, presumably the most likely reaction around 1,000,000°. But even at 20,000,000°, its rate would only be sufficient to consume all hydrogen in a star during the course of several billions of years, which is removed from an explosive reaction by at least a factor of 10^{17}. At 1,000,000°, the reaction must be considerably slower than this.

THE FISSION OF WATER AND AIR

Many scientists have asked me in recent letters why it is possible for the stars to have a sustained nuclear reaction if it is not possible for the water or the air to become ignited by an atomic bomb. The difference between the two situation is that in the sun the temperature i kept high because it is difficult for th sun's radiation to escape. The tempera ture in the sun changes very graduall from the 20,000,000° in the center, t the 6,000° at the surface. There is no where a strong temperature gradient an therefore the transport of radiation i very slow. If we explode an atomic bom under water, and even if we were to suc ceed in heating the water to the sam temperature as the center of the sun this high temperature would only be at tained in a very small volume. Radiatio would carry the energy away very rapidl to the surrounding water. This mean that in order to get a self-sustaining re action one of two things must be done First, the energy developed by the nuclea reaction must be so great that it over compensates the loss of heat due to radia tion. Even the most probable nuclear re actions discussed above fail to do th by a factor of at least 10^{26} at 20,000,000 and by a much greater factor a 1,000,000°. The second possibility is heat a very large volume of water simu taneously to a very high temperature, b this clearly requires enormous amoun of active material in the atomic bomb, e ceeding by many powers of 10 the siz of bombs ever contemplated.

The examination of possible nucle reactions has to take into account al other possibilities, involving rarer el ments, such as the reaction between tw deuterium nuclei. This reaction is t most probable known nuclear reaction low temperatures. However, even pu deuterium would fall far short of su taining a chain reaction at 20,000,00 and the very small amount of deuteriu in water will be of no consequence wha ever in this connection.

ACCURACY OF THE CONCLUSIONS

It is often argued that consideratio of the type here given involve a consid able extrapolation of present knowled It is my personal opinion that this is n the case. The energies of the nuclear pa ticles involved are very small—below t energies normally used in the laborato While we should be very cautious in e trapolating our present knowledge nuclear physics to higher energies, whe new phenomena will certainly come we have very good means of extrapol ing to lower energies. Such an ext polation involves only the use of standa quantum mechanics as embodied in t Gamow theory. This theory has alwa been confirmed by experimental inves gations of the cross sections of reactio

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The Moral Responsibilities Of Scientists . . . . A. V. Hill

E ETHICAL BASIS
MEDICINE

The problem we are to discuss today ery far from being a new one: indeed e responsibilities of scientists in mod- society' are as old as science and so- y themselves. Seventeen hundred years there crystallised out, from many turies of discussion and experience of moral basis and the ethical necessi- of medicine, the so-called Hippocratic h.

will look upon him who shall have ght me this art even as one of my ents. I will share my substance with , and I will supply his necessities, e be in need . . . The regimen I adopt l be for the benefit of my patients rding to my ability and judgment, not for their hurt or for any wrong. ll give no deadly drugs to any, though e asked of me, nor will I counsel . . . Whatsoever house I enter, there I go for the benefit of the sick, re- ning from all wrong doing or cor- ion, and especially from any act of ction . . . Whatsoever things I see or concerning the life of men, in my ndance on the sick or even apart efrom which ought not to be noised ad I will keep silence thereon, count- such things to be as sacred secrets. and holy will I keep my life and art'.

ithout an ethical basis to medicine zation itself as we know it might retty well impossible. The influence extent today of the national and in- tional agencies described under the of the Red Cross show how potent in spite of totalitarian war, is that l background. Medicine was the first remains the most difficult of all the ral sciences, the mother of many of ; and it is surely of extreme signifi- that tradition has attached to the name the Hippocratic Oath and the ocratic Method—the ethical injunc- on the one hand, the scientific claim ecide by observation and experience e other. Medicine has been built up joint tradition of scientific method oral value incarnated and hallowed single human personality.

AL STANDARDS
CIENCE

other sciences lag many centuries d medicine in the ethical approach eir practitioners to their job: the ate purpose of our discussion today see if anything can be done about it. was a time when science and learn- ere accepted as a natural bond be- nations often otherwise not on ing terms: they might still be so if ists in all countries would, or could, insist on maintaining a common ethical standard for their calling. Failing that, one can foresee the time when scientific discovery and invention may provide instead one of the chief stumbling blocks to international co-operation and the chief means for mutual destruction. If standards of truthfulness, frankness and integrity are relaxed, either for political motives or for private ambition and gain: if fraud, dishonesty and self-deception are not denounced, if mistakes are not honestly acknowledged and corrected, if propaganda is accepted in place of fact: if the common prestige and good-will of science are prostituted for base, sectional or selfish purposes: if secrecy or secretiveness is accepted as a normal condition of scientific work: if age, prestige or authority, if race or nationality, is allowed to hinder freedom of intercourse, or equality and interchange of ideas, between scientists of honesty and good will anywhere in the world: if there is widespread failure to recognize an unbreakable obligation—as it should be—that the benefits of scientific discovery must be regarded as a sacred trust for mankind: then, science itself may become impossible as a calling for free and honest men, while its exploitation for sectional gain, or national aggrandizement, may lead to conflict and destruction instead of co-operation and welfare.

THE ETHICAL
PROBLEM TODAY

It took hundreds of years for a common standard of medical ethics to emerge: we can scarcely expect a common standard of scientific ethics to appear ready-made. All kinds of difficulties will be evident, partly from political barriers and lack of freedom, partly from scientists themselves who are—many of them—pretty peculiar creatures to steer in a common direction, not least from the big bosses who look upon science as a purchasable commodity and scientists as back-room-boys to be kept in their proper place. But the matter is urgent and these are critical times, and a clear and unambiguous statement of the problem may help—as it helps any scientific problem—towards its solution. There is no suggestion—at least I make none—that scientific men as such need feel an obligation to spend their time directly in political, social or economic affairs: they have their own expert contribution to make to public and international welfare, and their experience in natural science gives them no special qualification for politics, sociology or economics. Indeed a dislike of misrepresentation and of compromise with the truth makes them usually pretty inefficient politicians. Like other citizens they have their political rights and social duties: they exercise them not as scientists but as citizens. As scientists, however, they have the right, and duty, to question and discuss the nature of their own calling and its special contribution to national and international welfare. They should feel an honorable and unbreakable obligation to keep the scientific faith of frankness, honesty and integrity: to avoid secrecy and secretiveness as necessary conditions of their work: to treat all honest scientific men anywhere as their co-workers in a common cause: not to exploit the common property of science for base or selfish ends: and to refuse conditions of employment or advancement, however otherwise attractive, which do not meet the ethical requirements of one of the most important common interests of mankind. I would add one further duty, to refuse to co-operate in tasks in which they, or their representatives, are not allowed a reasonable share or partnership in the responsibility of deciding on the purpose, policy or probable result of their work.

CONCLUSION

To a cynical observer of the recent behavior of *homo sapiens* these moral reflections may seem naive: and I admit I often feel sceptical myself about the outcome. But I see no alternative: we scientists throughout the world must take the initiative in these matters and not leave it to others who may wish to use us as their tools—otherwise we and civilization will perish together. The world at present is infected with partisanship, mistrust, political conjuring and the witchcraft of words and phrases: the common lot of mankind will not be raised by such devices of expediency: a common motive of principle, morality and co-operation is required. That motive, if we scientists have faith in our method and ideals, we can help to provide. No grandiose plan for conducting an international scientific orchestra is wanted: that would certainly play out of tune and out of time—if it played at all! We must build patiently on existing foundations—or, as a better metaphor, we must tend and care for the living organism of friendly international relations in science which already exists. The need is not for working drawings of new machinery: living organisms do not grow to maturity that way. What is needed rather is the inspiration of a great ideal, a common interest, a common standard of ethical behavior, a common refusal to sacrifice or exploit a universal good for a temporary or sectional advantage. How we can

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How Germany Lost The Race . . . . S. A. Goudsmi

I was connected with the War Department mission which was sent overseas to investigate the progress made by the Germans on the atomic bomb. My conclusions are based on having had access to all German material and on having contacted all key men on this project in Germany.

The German line of thought was as follows:

1. An energy-producing uranium engine is more likely to succeed than a bomb. In fact, they had entirely abandoned the hope of making a bomb during this war.
2. An atomic bomb is an uranium engine which gets out of control; therefore, the road towards a bomb leads via the construction of the uranium engine.
3. To make a bomb of pure plutonium never entered their minds, or at least was not considered feasible and not taken seriously. The idea of using a pile to produce plutonium and to make a bomb out of that material came to them only slowly, after the detailed radio descriptions of our bomb in August 1945.
4. An uranium engine is just as important as a bomb because it will make Germany economically self-supporting by the enormous power it may produce.

As a result they concentrated their efforts on the production of atomic energy, and all the work done was nothing else but trying to build what is called over here a pile, an uranium machine.

The Germans worked hard on the pile; at the end of the war they had merely come to the conclusion that a heavy water pile was possible. They never did construct a self-sustaining pile. They had not produced a chain reaction. The war ended too soon, and they probably would not have had enough heavy water for a working pile. They were also not aware, of course, of numerous new difficulties they would have encountered if they really had progressed with their attempt at building a pile.

The remarkable thing about the Germans is that throughout the war they believed that they were ahead of our effort along those lines. Not until the news broke that the atomic bomb had been dropped did they realize that they were not ahead, but that they were behind.

REASONS FOR GERMAN FAILURE

The reason for the lack of progress in Germany, as I see it, can be put down in a number of points.

The German scientists seem to have lacked the vision. They did not believe in success from the very beginning. They were convinced that the project was important; but they did not believe that it could be done within a reasonable time.

Another reason why the Germans did not make any real progress was that the key men in administrative positions were utterly incompetent. For instance, Army Ordnance had as its chief adviser on military matters a second-rate physicist named Schumann, and the scientists he had working with him were definitely inferior compared with the scientists who were available in Germany for such a project. Several other groups worked independently under different sponsorship—including the Air Ministry and the Ministry of Post and Telegraph.

It is clearly understandable that in such a way they could not go very far. It was only later, after the war went badly, that the thing was better coordinated and that one man was put at the head of the whole organization, a competent scientist. That was around 1943.

They were seriously handicapped by the lack of prestige which science has in Germany. When the war broke out, all German scientists were drafted. One of the top scientists was a corporal for a while, and stated that his Army experience was like the usual mountaineering, only made difficult by the presence of sergeants.

Pretty soon the key scientists were taken out of the Army and put back in the laboratories; but the bulk of the German scientists remained in the Army for several years, 2 to 3 years. Several were killed in action as soldiers.

Only when the war went bad, especially after the U-boat war went bad, were scientists released from the armed forces and put back on war work, which on the whole was not very successful, except for the Air Force.

Prior to the war, one of the key German scientists went around the country lecturing for various officials of the Air Forces, to point out that Germany was rapidly declining in the fundamental sciences.

He attributed it primarily to lack of support for science, to some extent to the loss of scientists because of persecution, and to a greater extent to the replacement of those scientists by incompetent party members instead of good scientists.

HISTORY OF GERMAN ATOM BOMB RESEARCH

Early in 1939, as was done in England, France and America, several German physicists called to the attention of the military and of other authorities the possibility of making a superexplosive as a result of the discovery of uranium fission. A group of physicists met and formed the Uranium Society (Uran Verein). This was originall an informal group, exchanging informatio among each other, but keeping such infor mation from outsiders.

German nuclear physicists proceede with their research independently. Arm Ordnance had a scientific group under second-rate physicist, Schumann, whic started work on this problem.

He went to France and tried to get th French development out of the hands o the French, and to move the French cycl tron. Later, he decided not to move it bu to make it work, and sent some German down to put it in order and operate it.

He had a small project going on in on of the Army proving grounds near Berli

The best-qualified groups were the Ka ser-Wilhelm Institute for Physics in Be lin, under Heisenberg, and the physics se tion of the KWI for Medical Research i Heidelberg, under Bothe. Bothe, as we as Heisenberg, made a survey trip throug the United States of America in the Sun mer of 1939.

At the beginning of the war, each ac demic research group had to find its ow sponsor. The German Air Forces had t best and most liberal set-up for researc and some nuclear physicists were fort nate enough to get support from them. private scientist, Baron von Ardenne, clever technician and businessman, got t Minister of Post and Telegraph, Ohn sorge, interested in his research. Ohn sorg was near to Hitler and kept t Fuehrer informed about the importan of the project. For awhile, von Arden was considered by the German authoriti to be the expert on the uranium proble much to the dismay of the really comp tent scientists.

The various groups worked in compe tion with each other. The sabotage a bombing of the Norwegian heavy wat plant had cut their supply so that it w barely enough for one group to ma important experiments. As a result, d agreements arose concerning its use.

The bulk of German scientific resea was under the Ministry of Education (M ister Rust). It was governed by a Resea Council under an incompetent administ tor and second-rate chemist named I dolph Mentzel, a brigadier in Himmle SS.

Early in 1942 the members of the U anium Society thought it necessary call the project to the attention of t highest members of Government and m tary organizations. A special secret me ing was called by Minister Rust a General Leeb, Chief of Army Ordnance, which all top-ranking officials were invit However, most of them declined or s

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nor representatives. It is doubtful
ether this meeting had any success.
A few months later, the Research Coun-
was taken out of the Ministry of Edu-
ion and, by Hitler's decree, placed under
ering. It was hoped that this change
uld bring research on other subjects up
the same high level as that of the air
ces, but matters did not turn out that
y. The incompetent Professor Mentzel
nained the active head of the Research
uncil.

Professor Esau was put in charge of
nium research. Later, some time in
3, he was replaced by the physicist Wal-
r Gerlach, of the University of Munich,
eally first-class experimental scientist
organizer. At the same time, Army
nance seems to have gotten tired of
apparently hopeless research and
ed the facilities and men over to the
earch Council. Upon Gerlach's shoul-
fell the difficult task of reconciling
two principal groups working on uran-
—the Kaiser-Wilhelm Institutes and
former Ordnance Group.

the meantime, Allied bombing had
ed the scientists to evacuate their
-equipped laboratories in the cities and
eek shelter in rather primitive quar-
in various small villages spread all
Germany.

studying the Research Reports, one
rst of all, impressed with the slowness
e progress. At the beginning of 1945,
of the research was still in practi-
the same state as it had been in 1943.
ope separation had been tried only on
ry small scale, by means of a centri-
. It had been found that the Clusius
od did not work. Research on several
r methods had been dragging on for
v years without much progress.

me of the key scientists worked only
time on this important research and
rest of the time did routine teaching
ministrative work. The lack of proper
-scale facilities necessary for this
of work was, of course, another rea-
for the lack of success.

tempts were made to have German
ical industry produce heavy water
se the Norwegian plant had been
oyed. However, not much progress
made with this plan either. Uranium
was produced in quantities sufficient
mall-scale experiments, and the stock
avy water seemed to be just enough
hat.

e effort was small, though it had the
st priority among all scientific re-
h projects in Germany. The total ex-
ture was about 15,000,000 marks,
is perhaps equivalent to some
00,000. The appropriation for 1944-45 was 3¼ million marks with a subsequent supplement of 1,000,000.

It is estimated that approximately 100 scientists were active on this project. They were divided into several rather small groups working on different phases of the problem, and were spread all over Germany.

SECRECY IN THE GERMAN PROJECT

Almost nothing was known here about the German project before the invasion of continental Europe, in spite of the fact that the German security provisions were not of a very high standard. Letterheads and envelopes were used which clearly indicated the prominence given to nuclear physics, reading "The Marshal of the German Reich, President of the State Research Council, Plenipotentiary for Nuclear Physics," or "The Plenipotentiary of the Reichsmarshal for Nuclear Physics," which gave Gerlach the nickname of "Reichsmarshal for Nuclear Physics." In draft deferment requests, the reason was clearly stated as "Working on Energy Production from Uranium." There were some weak protests against this lack of security, but to no avail. However, this stationery was never used for correspondence with neutral countries. The locations to which the laboratories had been evacuated were kept very secret.

German scientists knew practically nothing about Allied developments, aside from what they picked up in the summer of 1939. They received some utterly wrong and useless information from the German intelligence, information obtained from travelers or other unreliable sources. There was a rumor in 1943 that the German intelligence had information about atomic bomb-work being performed in the United States. This apparently was not taken seriously, as further details were lacking.

PROJECT RESULTS AND POLITICAL POLICY

Toward the end of the war, the German experiments had indicated that it was possible to obtain an increase in the number of neutrons, but no self-sustaining neutron source had been constructed as yet. The German scientists considered this achievement of great importance. They were convinced that they were far ahead of the Allies. They believed that this success might play an important role in the settlement of the peace terms, for they understood correctly the immense implications of the uranium-energy project. Even if the peace terms might not be influenced by them, they hoped that this achievement would at least insure for German science a leading role in the world and save Germany in that way. These thoughts were, indeed, the driving force behind the German scientific efforts. Gerlach was greatly excited when he learned about the favorable result of the preliminary experiment. He immediately informed Bormann, the head of the Nazi Party, reassuring him of German supremacy in this field. Gerlach was quite upset when, shortly afterward, the S.S. spread rumors that the Germans were soon going to use a uranium bomb. The scientists knew that they were still far away from that goal.

Himmler's S.S. had begun to take an active interest in research and especially in the uranium project. This organization had threatened to evacuate key scientists and their equipment to the Bavarian redoubt where they would be forced to complete the work under pressure. To the relief of the frightened German scientists, this plan failed, probably because of the rapidity of the German collapse. Only one group was actually kidnaped by the S.S. and let loose in Bavaria.

CONTROL PROBLEM

In my opinion, a survey of the German work on uranium energy leads to certain recommendations for eventual control of uranium research.

It has become evident that such supervision can only be had with the help of qualified scientists. The present military methods of intelligence or of occupation are totally inadequate for the control of scientific research. These merely lead to such utterly useless extremes as the destruction of the cyclotrons in Japan.

As soon as our mission got in touch with the first physicists, the first physics laboratory, the first correspondence and documents on physics which were available on the Continent, we obtained the complete story. If there could be free interchange of ideas among the scientists, if they could travel freely, if they were allowed to visit each other's laboratories, if that were possible, then as long as scientists are working or have to be used in work on an atomic bomb or anything of that nature, I don't believe that it can be kept secret.

The scientific cooperation which exists among scientists all over the world overcomes the barriers of war and differences of political opinion. I feel certain that, if all countries grant complete scientific freedom to their research workers—the scientists' free choice of research problems and freedom of publication — no dangerous activity will, or can, be kept secret as long as scientists are involved.

An Appeal To Reason . . . . E. U. Condo

The last war's destruction far exceeds that of any catastrophe yet known. The war ended with the application of a new weapon that is a thousand times more frightful than the weapons which produced most of the war's frightfulness. And already we have responsible statements from scientists who made this development, that bombs a thousand times more powerful than those already used are capable of being made in the near future. There are men living who know how to make a single bomb whose destructiveness is equal to a million ten-ton blockbusters. One such bomb, dropped on Washington or any other major city, may be expected to wipe out its population, to destroy its buildings utterly, and to render the site uninhabitable due to poisoning by radio-active materials.

THE CHOICE OF ATTITUDES

In the face of this situation, people react essentially in one of two ways. The first kind say: "It's just another weapon. Mankind learned to adapt itself to the long bow, and the cross bow, and the B29. We have always had wars." An extreme expression of this kind of pessimism is found in a speech by Prof. Leslie A. White of the anthropology department of the University of Michigan. He says, "As for the extermination of the human race as a consequence of hurling atomic thunderbolts, this too may be admitted as a possibility, and all we can say is that if it is to come it will come. Extravagant expressions of horror will not alter the course of events."

In our language, "extravagant" connotes exaggerately inaccurate and thus detracts from the serious warnings which responsible physicists are trying to give us. Now I would agree that expressions of horror alone will not alter the course of events. But I insist that if we look at what civilization has suffered in World War II, even before the atom bomb, and couple it with the picture of a war with plentiful use of "old-fashioned" atom bombs, and further with the picture of a war with both sides equipped with the really potent 1950 models — then, I say, no expression of horror of which our hearts are capable can be exaggerated or extravagant. I say we need not and should not fatalistically await death, while reading papers to an academic society in Philadelphia.

The second kind of people react differently. They say, this is the end of the road. Mankind has brought down suffering and death on its head, spiritual values have been destroyed, hatreds have been nourished and developed into great social cancers by war, and the war fears, and the war suspicions and divisions among men. This has been going on since the beginning of time and will surely destroy us all if we let it continue. We say simply that this must stop. We read the lesson of history to be that men can go forward together, and that men can progress to new freedoms, and new areas of social adjustment. The magnitude of the present crisis is such that we must soberly think of the choice as being between drifting into a war which will lead to the destruction of civilization, leaving a remnant of stunned, confused, poverty-stricken, frightened men and women amid the ruins,—or a wholesome healthy development of a united mankind, using its intelligence cooperatively for the good of all.

I beg of you, cast in your lot with the persons of the second kind—the people who believe there is a possibility that men throughout the world can live in freedom and justice, in love and good-will, that they can devote their full energies to constructive application of the rational thinking we call science to the arts of peace. In asking you to join with us, I make no promise of certain security. I only promise hope, and tell you that the other way leads to certain doom. If we try to establish the brotherhood of man on earth we may fail, but if we do not even try we shall surely fail, and what an unbearable load of guilt our consciences will then have to carry.

We must assert ourselves in every kind of agency of world cooperation toward positive wholesome working together for human welfare. This means specifically support to UNO, UNRA, and UNESCO and whatever other such activities lie ahead.

We must particularly seek to bring about closer working relationships with the Russians. Russia and the United States are today the most powerful nations in the world so unless we can get along together, there is no hope for peace.

SCIENTIFIC AND MILITARY PROCEDURES

We must regain for all scientists that freedom from military domination which is so necessary if science is to be used for peaceful ends. With militarism not wholly exterminated in the world, we must have scientists contributing to the development of our tools of war, since, God forbid, we may, if all else fails, have to use them. But the scientific life of the country must not be subordinated to, nor derive its chief support from, the military.

This is essential in the interests of the military themselves. Because the scientific spirit is so completely opposite to the military spirit, science simply will not go forward under military domination. Nowadays men must work together in lar organizations. It is characteristic of t military organization that operations a planned and directed from the top, wi the details executed by men below, by pe sons who unquestioningly and obedient respond to the orders given them fro above. The flow of original thinking from the top to the bottom. I concei just the opposite to be true in a proper administered scientific organization. T function of a scientific director is to s up working conditions where the lowlie novitiate is put in touch with all the pro lems in his field and encouraged to wor about them and to come out creative with new ideas and results. He is the so judge of what knowledge he needs in o der to work effectively on his proble The flow of original thinking in this ca is mainly from the bottom to the top.

Every worker must have access to t whole story because no one can fores which scientist will have the truly cre tive idea. And each scientist must free to discuss his ideas, while in t formative state, with his colleagues an where, for it is from the working toge er of many minds that new science com

In contrasting the military and scie tific, I do not wish to imply that one wholly wrong and the other wholly rig Just as I do not recommend the milita procedure for the conduct of scientific search, neither would I want our safe to depend on the outcome of a battle which the scientific method of free d cussion, independent thinking and mutu criticism was followed by all the captai and lieutenants on the battlefield. Mi tary operations and scientific research two quite different kinds of human acti ty and neither should be subordinated the other.

THE DOMINATION OF SCIENCE BY THE MILITARY

Of course my reason for stressing t point is that right now we are confron in America with a situation in which s entists are being held very strictly und military domination, to the severe det ment of our scientific development and t development of wholesome internation relations.

What is going on? Prominent scienti are denied the privilege of traveli abroad. Physicists are not allowed to d cuss certain areas of their science w each other, even as between individu working on closely related phases of t same subject. They can only communic through official channels, involving c sorship of their communications by ar officers without knowledge and so with competence. Information essential to u derstanding is being denied to stude

(Continued on page 7)

. U. Condon—Cont.

our universities, so that, if this situa-
on were to continue, young students will
t from their professors only a watered-
wn army-approved version of the laws
nature.

In this connection one is reminded of
e Holy Scriptures where in the 18th
rse of the 8th chapter of Ecclesiastes
read,

"Wisdom is better than weapons of
r; but one sinner destroyeth much
od."

The laws of nature, some seem to
nk, are ours exclusively, and that we
keep others from learning by locking
what we have learned in the labora-
y and not telling it to our allies. Later
y will learn what we know and more
ides, which because of our unfriendly
avior, we cannot expect them to tell

t is sinister indeed how one evil step
ds to another. Having created an air
suspicion and mistrust, there will be
sons among us who think other nations
know nothing except what is learned
espionage. So, when other countries
ke atom bombs, these persons will cry
eason" at our scientists, for they will
it inconceivable that another country
ld make a bomb in any other way ex-
t by aid from Americans.

et us cast this isolationist, chauvinist
son from our minds before we corrode
hearts and arouse suspicions of our
ives in the minds of the decent peoples
the world. Let us cooperate whole-
rtedly with the other nations of the
ld to agree to use atomic energy only
peaceful purposes and to set up an
ection system to enforce such agree-
t. The United Nations Assembly has
imously voted to establish an Atomic
rgy Commission to draw up such a
. In the face of the frightfulness of
nic warfare, it is inconceivable to me
any nation will refuse to participate
program of international cooperation
inspection. Yet, much public discus-
, and even more private conversation,
ased upon the assumption of such a
sal. We must push forward with all
ible speed in order to find out where
stand in the world today so that it is
longer possible for different groups
different nations to base their think-
and their planning upon different hy-
eses. I am confident that if we do
the outcome will be world friendship
cooperation, and not atomic war and
destruction of civilization.

closing I would like again to quote
ture, this time the New Testament,
verse of the 8th chapter of Luke:

or nothing is secret, that shall not
ade manifest, neither anything hid,
shall not be made known and come
ad."

THE CANADIAN ATOMIC ENERGY PROJECT

The "spy scare" has atracted attention to the part played by Canada in the research which led to the development of the atomic bomb. The following is a brief outline of the Canadian project.

* * *

Before the fall of France, French scientists working on the problem of atomic fission were sent by Professor Joliot to join the British scientists. Towards the end of 1942, the British proposed that an important section of the work should be carried on in Canada as a joint enterprise.

The primary material required for the production of materials for atomic bombs is **uranium.** One of the world's two most important deposits of this substance was discovered by Gilbert LaBine near Great Bear Lake in Canada. To preserve this important asset for the people of Canada and to protect the supply for the United Nations, the Dominion Government took over the ownership of the mines and the extraction plant.

A **pile** has been built in the Chalk River township situated on the south bank of the Ottawa river near Petawawa on a 10,000 acre site appropriated for the purpose. It will also produce large quantities of radio-active materials for application in medicine and research, and will provide a powerful source of neutron rays for research on atomic physics.

The construction of the plant followed an agreement in April, 1944 of the Combinde Policy Committee representing the United Kingdom, the United States and Canada. This Committee, under the chairmanship of Mr. Stimson, United States Secretary of War, and with Canada represented by Mr. Howe, was created as a result of a discussion between the partner governments at the Quebec Conference in 1943, to bring research work directed towards the atomic bomb in Great Britain and Canada into the closest co-operation with the tremendous undertaking in the United States. The Commitee agreed that a **pilot plant** for the production of plutonium, a pile containing uranium metal and heavy water should be constructed in Canada, while the United States should concentrate on two other methods of producing fissile material, the production of plutonium in the uranium-graphite pile, and the separation of U235 from natural uranium.

The fundamental design of the plant has been the work of the Montreal Laboratory of the National Research Council. This laboratory was set up in Canada in 1942 for uranium research and staffed by a combined group of scientists from the United Kingdom and Canada, and included some from France assigned by the Free French authorities to collaborate with the British scientists. The Laboratory is administered by the National Research Council under its president, Dr. C. J. Mackenzie, and directed by Prof. J. D. Cockroft, Jacksonian Professor of Natural Philosophy, Cambridge University, England, with Dr. E. W. R. Steacie of Ottawa as Deputy Director. Its staff has now grown to over 400 and it has been described as the largest organization ever created in Canada to carry out a single research program.

The erection and operation of the pile have been entrusted by the Department of Munitions and Supply to the crown company, Defence Industries Limited. Broad policy in design and operating procedure is decided on behalf of the Government by a Committee of Management under the chairmanship of H. Greville Smith, Vice-President and General Manager of Defence Industries Limited, which includes A. B. McEwen, M.E.I.C., Manager of Special Projects of Defence Industries Limited and H. J. Desbarats, Works Manager of Petawawa plant. The National Research Council is represented on the committee by Dr. Mackenzie, Dr. Cockroft, Dr. Steacie and R. E. Newell, Head of the Division of Engineering in the Montreal Laboratory. The Department of Munitions and Supply is represented by A. N. Budden, M.E.I.C.

* * *

Since the American methods for the chemical separation of plutonium have not been shared with the Canadians and British, it must be assumed that the latter have developed their own processes. In fact, it has been asserted (Senate Committee Hearings on Atomic Energy, part 2, p. 281) that their method is superior to that employed at Hanford, but we are not certain about it since secrecy works both ways.

LONDON CONFERENCE

A conference on the general subject "Science and Welfare of Mankind" was held in London, England on February 15-17, under the auspices of the British Association of Scientific Workers. Representatives from many European, South American, and Asiatic countries attended. Dr. John Simpson, Chairman of the Executive Committee of the ASC was present at the meeting, as observer for the Carnegie Endowment for International Peace.

We will present a more detailed report on the London meeting in our next issue.

The Atomic Bomb and International Organization

. . . . *James T. Shotwel*

In all the history of politics there is nothing comparable to the revolutionary effect of the atomic bomb. Its announcement by President Truman last August was a solemn warning, even in the heart of the war, that the weapon which scientists and engineers had created might destroy not only civilization but the earth itself unless it could be brought under effective and responsible political control.

Yet no political body existed, or ever has existed, capable of exercising the control necessary to meet so great a danger.

The first and most natural impulse was to demand, immediately, a world government capable to provide a universal guarantee of safety against universal danger. It is significant that this movement for world government was strongest in those very nations whose political structure is based upon the English tradition of representative self-government. Paradoxically, this demand that national sovereignty be surrendered to world governoment was based upon a theory almost wholly contrary to that upon which representative self-government is founded. World government seems to have been conceived as a device for safety; and safety under the conditions of modern warfare calls for quick executive decisions and immediate exercise of power because of the deadly timetable which has to be met in the hour of crisis.

What is needed is an international system for peace and security which, while providing against the danger of scientific warfare will enhance, rather than lessen, the growth of domestic freedom. That, then, is the modern political problem created by the scientific revolution of today.

Clearly it is not a problem which can be solved by concentrating all attention upon the conquest of the atom, or even upon all the other major achievements of modern science. For political problems cannot be solved by ignoring the nature of politics or the history of the national state.

NATIONAL STATES—AND WAR

The nation which pioneered in developing the national state was England, and the time was the seventeenth century. The British Parliament took over the prerogatives of kingship and the liberties of citizens were guaranteed in an epoch-making Bill of Rights.

It was to preserve liberties thus won that, almost a century later, English colonists in America declared their independence and set up safeguards of individual freedom in a Constitution and a Bill of Rights.

On its heels had come the French Revolution with its Declaration of the Rights of Man and the Citizen. When, in sequence, other European peoples, throwing off their despotic governments, established new systems, most of them followed the English model. However, the prevalence of wars there gave to the military class an importance denied them in the British Isles. This trend toward autocracy was checked throughout the nineteenth century by liberal movements, but finally culminated in the Fascist-Nazi philosophy.

From this outline of a vast range of history it is evident that war or the threat of it is the chief enemy of freedom, not only to conquered peoples but to their conquerors as well.

Throughout all the past there have been protests against the horrors of war, and idealists have ventured to draw plans for permanent peace. Yet these efforts had little or no practical effect upon the policies of nations prior to the twentieth century. In 1914, war was still the admitted arbiter of the fate of nations.

ATTEMPTS AT GENEVA AND WASHINGTON

In 1919, the Covenant of the League of Nations took a step forward when, in Article I, it declared that "war or the threat of it anywhere in the world was a matter of concern to all members" and that the Council should take such measures as it deemed necessary to preserve the peace of nations.

This was as far as the world was willing to go at the end of World War I; and as history proved, was even more of an obligation to preserve the peace than most of the nations were willing to accept. The U.S.A., itself, kept out of the League—weakening the fabric of world solidarity.

Then the movement toward disarmament was taken up at the Washington naval disarmament conference in 1921. Continental European countries refused to accept the American lead. They insisted that nations could only disarm in proportion as they were granted security by other means. Their reasoning was sound, as we would have recognized had our frontier on the East been the width of the Rhine instead of the Atlantic Ocean. Nor did the League of Nations itself offer them a full guarantee of peace. Consequently the Europeans set about implementing the League Covenant. In 1924, the Assembly passed what was known as the Protocol of Geneva, an amending treaty to be accepted by all League members. In this, war was at last declared to be an international crime and the nations bound themselves together to protect each other in case any nation went to war agains any other.

Had this Protocol of Geneva been adopted the Second World War could not hav happened as it did. Unfortunately, th conservative government which their cam to power refused to ratify the Protocol—insisting that it must be its own judge a to whether the accused nation was reall an agressor or not. Thus a great fabri of European solidarity to preserve th peace broke down—this time by the refusa of the British to accept the political judg ment of the League.

The outstanding conclusion from th experience gained between 1921 and th outbreak of the second World War is tha there will be no way of checking the rac in atomic weapons in future years unles at the same time we set about the elimina tion of war itself; and that the outstandin example of how his can best be done is th unratified Protocol of Geneva.

THE UNO CHARTER

This is the history which lay behind th making of the Charter of the United Na tions, framed at San Francisco. The Char ter contains the obligation that "all mem bers shall settle their international di putes by peaceful means in such a manne that international peace and security an justice are not endangered." Unfortunat ly this commitment is in what might b regarded as a preamble; and althoug Chapter 6 provides an iron-clad syste for settling disputes peacefully, the ve of the Great Powers might conceivably b used by any one of them to escape th final jurisdiction of the Security Counc itself.

The situation therefore, at the prese time, is that the Charter needs to be bu tressed by additional treaties, one to in plement its control of armaments and th other to provide a realistic, binding cov nant against war itself.

With reference to the international co trol of atomic weapons, a good case cou be made for placing the control in th hands of the Assembly rather than of th Security Council, because the Assembly in theory, the supreme body. Accordin to Article 11 of the Charter, "it may di cuss any questions or matters within th scope of the Charter" and, under Artic 11, "may consider the general principl of cooperation in the maintenance of inte national peace and security including th principles governing disarmament and ma make recommendations with regard to su principles to the Members, or to the S curity Council, or to both."

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The Atomic Bomb and International Organization

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. . . . *Continued*

The Security Council, on the other hand, an emergency body primarily concerned ith the settlement of disputes. However, is also responsible (Article 26 of the harter) "for formulating with the assist-ice of the Military Staff Committee... ans to be submitted to the members of e United Nations for the establishment a system for the regulation of arma-ents." Under this provision the Security ouncil thus has a more definite mandate an the Assembly to deal with armaments.

The Assembly recognized this fact when set up a Commission for the Control of omic Energy—for it made the member-ip of that commission identical with the embership of the Security Council with t one exception, that of Canada. It also rected the Commission to submit its ports and recommendations to the Se-rity Council.

Furthermore, in order to leave no pos-ility of doubt as to the place of this ntrol Commission in the UNO, the reso-ion of the Assembly stated that "in w of the Security Council's primary ponsibility...for the maintenance of ernational peace and security, the Se-ity Council shall issue directions to the nmission in matters affecting security." ly in matters not affecting these grave estions of war and peace would the Se-ity Council be called upon to transmit orts of the Commission to the Assem- or to the Economic and Social Council. n short, the Council retains final control h reference to recommendations "for elimination from national armaments atomic weapons and of all other major pons adaptable to mass destruction" for the erection of "effective safe-rds by way of inspection and other ns to protect complying States against hazards of violence and evasions."

PARTITE ADVISORY BODY

the Security Council needs a **military f committee** to advise it on armanents he pre-atomic age, surely it will require services of a **technical body** to analyze problems and to prepare plans for the rol of atomic energy. Only highly petent specialists can say whether the guards which have been proposed are uate or not.

n the other hand, it would not be wise eave the whole problem entirely in the ls of scientists. There should be, along- the scientists, men who are experi-d in the conduct of public affairs and cially in the working of international nizations. And along with both, the ary experts—not to dominate discus-s but to prevent the conclusions from losing sight of their main objective.

I suggest, then, that a tripartite body of this nature is necessary for the effective carrying out of the purposes of the commission on atomic energy. Its power, however, should be limited to recommendations to the Security Council. A technical body, no matter how highly qualified by knowledge and experience, should not have the final decision—even in matters that lie so largely within its field as that of atomic energy. But such recommendations by a body as competent as this could not be readily passed over by the Security Council.

INTERNATIONAL INSPECTION

Preliminary studies have already shown that it is impossible to devise a system of inspection which would be a perfect safeguard against surreptitious violation.

Scientifically, therefore, one can say inspection will break down, for it can never be absolutely complete. Politically, however, it may be adequate—and this is a point of supreme importance—if it can be developed to the point of indicating where a nation or an enterprise within a nation seems to be engaged upon suspicious activities or becomes unduly secretive concerning its activities. Now there is reason to hope the technique of international inspection can be carried this far with enough guarantee against evasion to permit nations to proceed with their peaceful activities, unhampered by the haunting fear of secret preparations for atomic war against them.

The establishment of international inspection may therefore be something more than a first step towards international control. Even if no other steps were taken looking to the enforcement of peace, an agreement not to keep armanent preparations secret might eliminate from international relations the poison of suspicion, which is one of the deadliest of all poisons in human affairs. But this first step implies the second one of international supervision of control. There must be force behind the agreements, and that force must be adequate to rid the world of any threatened illegal use of "atomic energy and other major weapons of mass destruction." It is wrong, however, to deal with this problem wholly in terms of police power. The principle upon which the new world order must be based, the only principle upon which peace will be secured, is that of the common interest of all nations in the elimination of the greatest danger of all times. It is not enough merely to get rid of armaments. The atomic bomb has at last made clear the imperative need of getting rid of war itself.

THE PREVENTION OF WAR

Following the model of the Geneva Protocol, the prohibition of aggressive war must be made real and to make it real it must not only have force behind it but it must rest upon a definition of aggression which, if applied, will curtail the application of the veto power, and insure rapid and effective action against an aggressor. The definition needs to be reconsidered in the light of atomic warfare, but the fundamental principle of the Protocol remains: namely, that any nation is an aggressor which turns from the peaceful means which it has already accepted for settling disputes and prepares for war instead.

In applying this definition, the first question that arises is at what point in a situation which looks like a threat of war the international organization should step in, and how. This is the point at which most plans for world peace have broken down. But now the way lies open for its solution, if the provision for inspection of atomic weapons becomes an established routine and is not in the hands of militarists. **The detection of any conspiracy against the peace by a commission largely made up of technical experts would be more devoid of political prejudice and more objective in fact-finding than any purely political arrangement of governments.**

Thus the problem of inspection could be made to work directly toward the prevention of aggressive war. I have not the slightest idea whether this suggestion will be deemed practical by those responsible for our policy but I am of the opinion that it is the best way open to us now to achieve results which are absolutely essential if civilization is to endure.

In line with this conclusion, I may revert to my opening paragraph and point out that there is no more definite lesson from history than that the military authorities of a nation should not be master of its policies either directly or indirectly. This is not a new challenge. It has confronted civilization at the close of most wars in modern times. I do not anticipate any serious difficulty in this regard in our own country but we must be mindful of the situation—and of the dangers to freedom which have always occurred where the problem of security takes the upper hand over that of human welfare.

Senate Hearings On Atomic Energy . . . .

The hearings before the Senate Special Committee on Atomic Energy continued through most of February. In the last issue of this bulletin, we published detailed reports on testimony bearing most directly on the controversial subject of military vs. civilian control—by the Secretary of War Patterson, and by General Groves. The statements of Profs. Teller and Ridenour, dealing with the crippling effect of secrecy regulations on the advancement of science, were also reprinted in the same issue.

Among the other statements, presented during this period, were those by several industrial witnesses — J. D. Rafferty of Union Carbide and Carbon on February 7, G. Folk of the National Association of Manufacturers, and E. Bransome and F. Kett of the Vanadium Corporation on February 8, A. C. Klein of Stone and Webster, and B. Manly of Southern Gas on February 13, and J. C. Parker of Consolidated Edison on February 18. On the whole, representatives of the companies which had actively participated in the Manhattan Project favored the McMahon bill. These industrialists acknowledged the necessity of government monopoly of fissionable materials and agreed to the principle of national ownership of patents obtained in the course of government-sponsored development. A different point of view was taken only by the representative of the NAM, George Folk, who described the McMahon bill as a threat to private enterprise and requested that government activity in the field of atomic energy be restricted to the protection of the public from health hazards and explosion danger. Displaying little knowledge of the subject, he spoke of "new harmless fissionable materials" which are likely to be discovered and may find applications in industry without constituting a danger to the public.

On February 15, the committee witnessed a "round table" discussion on the subject of the destructive effects of the atomic bomb, with Major de Seversky facing a "united front" of scientists (represented by P. Morrison) and the Army, represented by T. A. Farrell, S. Warren, F. D'Olier and P. A. Nitze. We will treat this subject in our next issues.

Below, we give a summary of testimony on two special topics. One is the patent situation on the Atomic Bomb Project, and the other the attitude of the utilities towards the possible utilization of atomic power.

ATOMIC BOMB PATENTS

The testimony of Mr. Stewart and Capt. Lavender on February 11 brought the first authentic disclosure of the patent situation on the Atomic Bomb Project. Following is a condensation of the two witnesses and of the ensuing questions and answers.

PATENTS POLICY UNDER THE OSRD

Irving Stewart (Deputy Director, Office of Scientific Research and Development)

Research and development in the field of atomic fission was a responsibility first of the NDRC, and then of the OSRD, until the end of April, 1943, at which time the Manhattan District took over.

In its contracts OSRD used two patent clauses. The short form gave the Government the power to determine the disposition of all rights in discoveries and inventions made under the contracts. A number of vitally needed industrial organizations were unwilling to accept such a provision. This resulted in the adoption of the so-called long form. It left with the contractor the title to inventions, subject to a license in favor of the Government for national defense purposes.

The short form clause was used where the Government assembled a group of men to work in a field where enough information was not available in a single organization as, for example, in the Radiation Laboratory at the Massachusetts Institute of Technology.

When the program on atomic fission was taken over by NDRC, the initial contracts were executed with organizations which already had done work in that or related fields. These contracts contained the long clause. As the project grew, and the tremendous possibilities began to take shape, it was decided, in spring of 1942, that Government control should be strengthened through changed handling of patent rights.

The Standard Oil agreed to give the Government full control over inventions and discoveries. Thereafter Columbia University, Westinghouse, the M. W. Kellogg Company, the University of Chicago, the duPont Company, the University of California, and the other OSRD contractors all agreed to accept a retroactive change to the short form.

The result is that, under all NDRC and OSRD research and development contracts, the Government received the right to determine the disposition of all patents.

If the OSRD decided that no patent application should be filed on behalf of the Government, the Contractor could file in its own behalf with the understanding that he would grant to the Government a non-exclusive, royalty-free license for governmental purposes.

For inventions and discoveries in the atomic fission project, the general policy was established of vesting title to patents in the Government.

Senator Millikin: Without consideration?

Mr. Stewart: Without consideration, yes; and I can state flatly that there has been no consideration in any case.

PATENTS POLICY UNDER THE MANHATTAN DISTRICT

Captain Lavender (Advisor on patent matters to OSRD)

In addition to carrying on research and development, the Manhattan District had to make contracts for the quantity production of equipment.

Four patent clauses were used in the Manhattan District contracts:

(1) For research contracts we retained the regular short form patent clause.

(2) Sometimes this clause was modified so that the contractor could retain a non-exclusive license in the outfield. I mean by "outfield" commercial activities, and by "infield" any device, apparatus or process that is used in the atomic energy program. That clause was used where some information was given to the contractor as to the research work that had been done.

(3) In the third type of contract, the contractor retained the sole license with the right to grant sub-licenses. That contract was used where we went to a contractor in his own field of development but there was some engineering or redesign for the particular work that we were engaged in.

(4) The fourth group of contracts covers cases where the purchases are off the shelf, and a time was necessary ordinarily to investigate the patents that may be involved in this equipment. The clause provided that the Government would assume liability for infringement of patents. However, where we purchased equipment in which the manufacturer had had extensive experience this liability was assumed by the contractor.

Senator Millikin: Might a patent application give clues as to things that we might not want to reveal?

Captain Lavender: Those applications are still in the Patent Office. The Govern

(Continued on page 11)

(Continued from page 10)

nt has full control as to when they are ing to be released.

Senator Millikin: By what authority es the Government impose a wall of secy around an application?

Captain Lavender: 35 U. S. Code 37 s that when the title of an invention n the Government, the six months that given for an applicant to respond shall extended to three years; a claim can in the application which would not be owable, so that it is rejected again and n another three years is given. This the machinery by which Government control the date of issue of a patent.

enator Millikin: Suppose I today filed application covering the same subject ter as one of these impounded applions. What explanation would the Pat- Office make to me?

aptain Lavender: There is a law that ing the emergency the Patent Office issue orders of secrecy.

enator Millikin: The justification, in r words, is a matter of wartime neces- ?

aptain Lavender: That is right.

he Chairman: Are there any applicas in the Patent Office by private comies on atomic fission?

aptain Lavender: There are some that been filed by independent inventors.

e Chairman: How about applications "atomic energy devices?" Have any hese been filed by contracting firms?

aptain Lavender: No, we have filed all applications.

e Chairman: Have they retained— contractor—any claim to (a) the proion of fissionable material, or (b) the ication of fissionable material to ic energy devices in the future?

ptain Lavender: No contractor has ned any right to such inventions.

nator Millikin: How many people access to applications impounded in Patent Office?

ptain Lavender: The Chief Examiner his assistant were the only ones desed by the Commissioner of Patents andle those cases. They are kept in ate safes in the Patent Office.

e Chairman: Are there any patent cations giving the bomb making de- in those patent applications?

ptain Lavender: The bombs are cov- by applications.

e Chairman: I didn't dream, frankly, there was a patent application down showing how the bomb was put to- r.

ptain Lavender: I was reserving for xecutive session the special handling plications relating to bombs, which sure fully safeguards it.

The Chairman: Have there been any applications from foreign inventors on atomic bombs?

Captain Lavender: What they contain I do not know, but there are quite a good many applications by foreign inventors. There was one patent that had already been issued in France in the fall of 1939, which was filed over here a little over a year later and is still pending.

Senator Millikin: Would any of these contractors to whom you refer have refused to go ahead with their work had they not been given some patent right?

Captain Lavender: I don't know of a single company that ever said, "We are not going to do anything until we get all of these contract rights worked out."

Senator Millikin: Then those privileges are sort of a gratuity we have given them?

Captain Lavender: If we said, "We want the whole thing and you retain nothing", it would be natural for the Government to pay for all of the invention rights. Purely from a business point of view, we don't take more than we need.

Senator Millikin: Let us suppose that John Doe is a little fellow making a valve and Richard Roe is a big fellow making a valve, and you picked Richard Roe as the man to do a job for you. Now comes peace, and Richard Roe appears with a lot of improvements. Where does that leave this little fellow, John Doe?

Captain Lavender: The Government has the title to the invention, and can grant a license to the small man.

The Chairman: But is not the great bulk of the patent applications in the field where the outside company has an exclusive right?

Captain Lavender: These are inventions of the "third category", which are of not much importance.

The Chairman: If an individual or a company works in the atomic energy field at his own expense, there would be no way that you could get hold of it?

Captain Lavender: There is one part of the Espionage Act, which requires that information involving national defense come as a result of some relation with the Government. The Government could go to the inventor and place him under the Espionage Act, and he would not be permitted to disclose his invention. The Commissioner of Patents may be authorized and directed to notify the Atomic Energy Commission of the existence of an application in which reference is made to atomic energy, then the Commission should have authority to go to him and purchase it or make some other arrangement. This is in effect the seizing of the invention and restricting the inventor under police power.

The Chairman: That wouldn't change his ownership, but merely his right to divulge it?

Captain Lavender: That is right.

The Chairman: You would have to pay some compensation, I take it?

Captain Lavender: You could offer the compensation, but I think it would come under police power rather than eminent domain.

The Chairman: So Jones might make the greatest invention in the field and be deprived of any award for it?

Captain Levender: If he did not want to accept the award that was offered to him.

A person who has a patent cannot obtain from the Government the facts concerning the equipment that corresponds to his patent, if the Army and Navy do not desire to disclose it. The Court of Claims will not enforce a call for information against the Navy Department if the Navy certifies it involves the national defense. That leaves the claimant in the Court of Claims with a perfectly valid patent but no way to prove his case.

Senator Millikin: What do you know about the patent applications of Kellex?

Captain Lavender: The Kellex has granted a license to the Government under all of the patents developed before the date of the contract, that may be used in any of the plants.

As to the present conditions, they started out with a long form clause which was renegotiated to a short form.

Senator Millikin: Are those of enormous value, those exclusive license rights?

Captain Lavender: The license rights are non-exclusive, so the Government can grant licenses to other companies.

The Chairman: I believe duPont has made no claims at all for improvements or inventions.

Captain Lavender: duPont said they didn't want to have anything to do with the determination as to who inventors were. The Manhattan District took the responsibility of ferreting out the inventors. They were working with the University of Chicago, and they didn't want to let anybody think that duPont was going to grab up any of the patents.

Senator Millikin: But assuming that you fellows determine that a duPont man has made the invention, then what happens?

Captain Lavender: Then we will do our part to cooperate to get the application executed.

Senator Millikin: But what right would duPont then have in the application?

Captain Lavender: None.

The Public Utilities And Atomic Power . . . .

The following is a summary of the testimony before the Senate Committee, of John C. Parker, Chairman of Special Committee on Appraisal of Atomic Energy of the Assoc. of Edison Illuminating Co's.

The Committee proposes to avoid inquiry into the specific technique of the processing of fissionable materials. However, the appraisal would be aided by knowledge of the economic factors surrounding the materials involved in energy production by atomic fission, which we do not now possess in more than the most rudimentary degree.

It appears now that the two most likely fields of energy utilization are to be found in marine propulsion and in large land power plants. The committee, therefore, proposes to offer to the United States Navy such collaboration as the Navy finds to be consistent with the purposes of national security. It is believed that the committee can, through its familiarity with the problem of power plant design, construction and operation, be of some appreciable service to the naval authorities. It is quite possible, as was the case with higher pressure and higher temperature steam development, that large land installations may afford an excellent proving-ground for the exacting requirements of the Naval Service.

LARGE REDUCTION IN POWER COSTS NOT FORSEEN

It is proper to point out that zealously though the industry will seek to develop the possibilities, revolutionary results in the cost of supplying the public are not to be expected but rather sober, level-headed betterment. The reason for that is worth pointing out.

Most of the investment and much of the operating cost of present systems lie outside the generating plants—for example, in the distributing systems and in the multifarious services to customers.

It is evident, if this preliminary hypothesis proves correct, that the primary advantage to the national economy through the use of nuclear energy will be in the service of that part of the utility load in which fuel costs play the relatively biggest part, namely, industrial and heavy traction load, and that the economics here will probably be not much greater than the difference in fuel cost.

There has been some popular misconception as to the amount of energy that would become available through atomic processes. A clear perspective in this matter is to be had from a realization that never at any time has the country suffered from a deficiency in the amount of power available. Indeed it seems clear that the ultimate supply of energy available from coal and from water-power is more than sufficient for all the probable needs of the country for centuries to come. All that is necessary to expand the availability of electrical power is the construction of plants, transmission and distribution systems. Even more significant, however, are the much more expensive plants and devices for utilization. All this will be the case whether the source of energy is the atom or the more conventional sources. It is true that some expansion of electric energy use may result from the development of atomic energy in so far as such development brings about a reduction in cost of generation, and therefore makes possible the electrification of certain large scale chemical or metallurgical processes now carried out on a directly thermal basis. But that, if at all, will occur only after an extended period of time and as it proves economical.

OBSOLESCENCE OF PRESENT PLANTS NOT SERIOUS

Another popular misconception is that public utilities might be unduly apprehensive of the obsolescence of their plant. If nuclear energy will be used in the production of steam for high temperature turbines, the process will be analogous to a current one quite common to the light and power industry, namely, the use of so-called topping turbines. When new and more efficient heat cycles, using much higher steam pressures, and temperatures, became available, the utility companies recognized the possibility of removing some or all of their older boilers, of producing steam at high temperature and high pressure and then, in new turbo-generator sets, while doing useful work, degrading it to the level formerly produced in the lower pressure, lower temperature boilers and further using it in the existing turbines. A strictly analogous process seems quite probable when and if the technical and economic problems of atomic energy utilization are worked out. Old boiler plant and combustion equipment may be removed, giving place to the new type of boiler, with or without its own high pressure, high temperature turbine. Thus steam would be produced for use in the present turbo-generators either directly or through the intervention of an atomic topping turbine.

Senator Austin: What is meant by "topping"?

Mr. Parker: When it became possible to build steam turbines with their associated generators operating at temperatures of the order of magnitude of 950 to 1,000 degrees, and at pressures running up to 2,500 pounds to the square in relatively small turbines of that charac were produced which, after having do useful work in driving the electrical ge erators, exhausted their steam at mo moderate pressures and temperatur generally at the temperatures and pr sures previously used in the stations in which these new turbines were to installed. These turbines were high-spe relatively small units with their boile and where they were installed did abo half of the useful work of making ele trical energy, discharged their steam—st capable of doing a great deal of use work—into the older equipment whi didn't any more have boilers for supplyi them directly, and then roughly an equ amount of work was done in those low pressure, lower temperature turbo gen ators.

ATTITUDE OF UTILITIES ON LEGISLATION

In this connection the public util industry of the country has only one res vation and that is that atomic materi should be available for industrial use wi out differentiation as to the type of util to which it is made available and with t single collateral requirement that any sultant net economies be passed on to t consumers.

We completely endorse the theory th the processing of such materials must under the control of some such commiss as it is proposed in the McMahon bill 1717). The possibilities of misuse un any other scheme of production are ghastly to be contemplated. As a collate of such control, licenses for use seem qu inevitable.

It seems perfectly clear to me that any body of individual citizens with the most compelling restraints to h possession of the processes of product of materials which have demonstra their capacity to two Japanese towns j would be a complete subversion of ev element of public safety.

The Association of Edison Illuminat Companies regards as of distinctly mi significance any question of patent rig that may result from the studies of t committee or subsequent development co mittees.

The large scale technique of promot of the scientific knowledge had been at expense of the people of the country a whole. $2,000,000,000 of the resources the country have been put into this thi Now, it does seem perfectly clear t whatever may be the active agent in further production of fissionable mater the control of a thing created by the peo of the nation must rest in the people the nation.

Atomic Power Production . . . . Farrington Daniels

he energy of an atomic bomb can be d either to furnish heat, light, and ver to a city—or to destroy the city. simple control mechanisms the energy be released gently over periods of s, months or years—or it may be re-ed with explosive violence in less than illionth of a second.

onflicting statements about the prac-l uses of atomic power have been made different scientists, depending largely n whether a short-range view or a -term view is taken. It is fair to say, ever, that the outlook for future use-ess was probably no brighter for the steam engine and the first electric or than it is now for the first power

"pile" is made by simply stacking up nium or uranium-235 or plutonium a moderator of graphite or other able material which slows down the trons so that they will be better ab-ed in the uranium. The pile must not ess than a definite critical size, other-the external loss of neutrons will be reat as to prevent the continuation of nuclear chain reaction. Enormous tities of heat are released by the fis-process taking place within the pile.

e complete disintegration or "fission" he pound of uranium-235 results in the al loss of one thousandth of a pound atter, and according to the Einstein this loss is accompanied by the evo-n of eleven and a half million kilo-hours of heat. If this heat is used standard boilers, engines and dyna-it can be converted into about three on kilowatt hours of electricity.

VER PILES ARE HNICALLY FEASIBLE

th adequate support a pile could be and a good-sized turbine and dynamo be operated with atomic power n a year. Until recently all effort iles was directed toward producing nium for bombs. All other consid-ons were neglected. It did not mat-f large quantities of heat were util-only for raising the temperature of air over Tennessee or heating the of the Columbia river. For the of simplicity these piles were oper-at low temperature, under conditions that the heat is not suitable for con-on into useful power. But the pile ive off its heat just as well at high eratures, where the large tempera-difference is effective in producing r, just as a high waterfall is effec-or water power. The only limitation gh-temperature operation of a pile is bility of the materials of construc-to withstand the temperatures gen-d. This is a serious limitation which is already holding back the improvement of ordinary gas turbines.

A gas or liquid can be circulated through a heat interchanger which then boils water or other liquid to drive a turbine or standard engine. Assuming a tight heat interchanger, this secondary system is not then contaminated with radioactivity.

Hot gas swept through the pile can be used directly for driving a turbine. If the uranium is covered tightly to confine the fission products, an open-cycle turbine can be used in which the gas is allowed to escape—otherwise a closed-cycle turbine is necessary.

POWER PILES INVOLVE UNIQUE AND SERIOUS HAZARDS

In the fission process neutrons and penetrating gamma rays, similar to X rays, are given off at enormously great intensities. It is necessary to surround the pile with walls of concrete several feet thick in order to protect the health of the operators. The new radioactive elements produced by the fission of uranium or plutonium may be either solids or gases with decay periods of varying lengths. Since they can not be discharged into the air nor dumped out as ordinary waste, they must be retained in gas-tight enclosures. If they are allowed to mix with the cooling material which circulates between the pile and a heat interchanger, the radioactivity will be so serious as to destroy any organic material such as lubricating oil which may be in or near the circulating system. Ordinary repairs are impossible because workmen can not come near, and ingenious replacements by remote control must be devised.

If a pile should suffer an accident which scattered the material of the pile, a serious situation would be created, because no one could approach the scene for months to clean up the material.

There is no chance of an explosion of a power pile similar to an atomic bomb explosion, but if a large pile should ever get out of control it might heat up unduly and spread some radioactive material over the immediate surroundings.

There is no danger that the energy liberated in piles can touch off nuclear chain reactions involving the light elements in such a way as to lead to an atomic catastrophe which would destroy the earth or any part of it.

PRESENT ATOMIC FUEL IS MORE EXPENSIVE THAN ORDINARY FUEL

One pound of uranium-235, occupying only a little more than a cubic inch will give on fission as much heat as a trainload of 1500 tons of coal worth $7000. It takes 140 pounds of ordinary uranium to give one pound of uranium-235 and the cost of this much uranium is considerably less than $7000. However, when ordinary uranium is used in piles, the piles have to be of very large size and only a fraction of the uranium-235 can be fully utilized. More successful results can be obtained with pure or enriched uranium-235 or plutonium. The separation process, however, greatly increases the cost of the pure isotopic fuel.

It has been estimated that pure plutonium or uranium-235 must sell for $25,000 per gram to compete economically with coal, and for $50,000 per gram to compete with gasoline. The cost of production of plutonium and uranium-235 is considerably more than this—and yet the difference is not so great that all thought of future economic utilization of atomic power should be disregarded.

Another important item of cost is the chemical purification and recovery of the spent uranium. The accumulation of fission products poisons the pile and requires a change of atomic fuel.

It must be emphasized that the cost of fuel is only about one-fifth of the total cost of producing electricity for domestic purposes in locations where coal is easily available. The cost of distribution is much more and this cost is not affected at all by substitution of atomic power for coal. In other words, if atomic power could be obtained free the maximum possible saving could be only 20 percent. By the same reasoning, however, if one paid twice as much for atomic power as for coal, the cost of electricity produced would be increased by only 20%.

The shielding, the controls, the arrangements for operation at a distance, the precautions for health protection and the plant required for recovery and disposal all constitute large fixed charges which are not found in the standard power plants using combustion of coal or waterpower. Moreover, the amount of uranium-235 or plutonium used must be much larger than the amount consumed because the pile will not continue to operate after so much material has undergone fission as to reduce the pile to less than the critical size.

In isolated regions where transportation is difficult one doesn't count dollar values. If one chooses to build a city at the north pole one must have heat and power regardless of cost.

In Argentina, southern China and Mediterranean regions there are demands for power and heat but neither coal nor water power is available. These regions might properly look to nuclear power. It is com-

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Can Air or Water Be Exploded?

(Continued from page 2)

between light nuclei at low energies. In some cases, like the reaction between two deuterons, direct experimental investigations have been carried to very low energies. The greatest danger in making theoretical estimates at low energies seems to be the possibility of some resonance in this region. However, the calculations can easily be done, taking into account a resonance of the greatest possible strength, and even then the result is many powers of 10 below the possibility of a chain reaction.

Moreover, we have the experience of the stars to go by. All the elements abundant in water or in the atmosphere are also abundant in stars. If their nuclei were capable of reacting with high probability at any temperature up to 20,000,000°, this reaction would certainly occur in the stars and would consume the elements in question or greatly increase the energy production. This argument has the weakness that our concept of the exact temperature distribution in the stars is itself based on theoretical considerations. The astrophysical argument, therefore, should only be regarded as supplementary evidence, supporting the theoretical calculations based on quantum mechanics.

It appears, then, that atomic bombs of present construction are safe by enormous margins against igniting either the atmosphere or the water or the earth. There are good reasons to believe that even any conceivable future improvements of the bombs will still be safe in this respect. However, before any test of such an improved bomb, a detailed consideration, taking into account the particular features of the future bomb, will be absolutely essential.

It seems to me that the objection to the Navy test does not lie in the possibility of setting the ocean on fire. The objections which we, as scientists, have are concerned with the problematical significance of the first two tests as planned. This criticism has been thoroughly discussed in this Bulletin in the issue of February 15. We now hear with especially great concern that there are some discussions of abandoning the third test of the bomb, the one under water, which is the only test which can be regarded as significant. If this were done, it would be far better to abandon also the first two tests which will only serve to mislead the public as to the effects of the atomic bomb on ships.

More important still, let us not forget that over and above the Navy tests and the problem of igniting the ocean, there is one problem which is of really overwhelming concern to us all: the problem of international control of the bomb. While some scientists may argue that there might be a remote chance of our concepts of theoretical physics being false at some point which might invalidate our predictions, they will all agree that there is an immeasurably greater danger th[...] the peoples of the world will not ha[...] sufficient wisdom to settle their diff[...] ences before a war breaks out which w[...] be fought with atomic weapons. To dr[...] everybody's attention to this possi[...] catastrophe has been, and still is, [...] main concern of all of us.

Atomic Power Production

(Continued from page 13)

forting too to realize that after man squanders all his coal and oil he can still keep himself warm for a few centuries more with uranium.

Atomic power can be used to drive ships which will not have to be refueled for long periods of time, but the application to automobiles or small mobile units does not seem likely.

Extravagant statements have been made such as "There is enough energy in a breath of air to propel an airplane." If one refers to the theoretical and complete annihilation of ordinary matter this might be true, but this annihilation has not yet been accomplished, and the only large-scale production of atomic energy involves the "chain-reacting" fission of uranium or plutonium.

CONCLUSIONS

Using piles similar to those now built, atomic energy cannot be used economically in this country in competition with coal. There is no chance that atomic power will render obsolete any of our present power-producing equipment within a period of at least ten years. New developments may bring the cost of atomic power down to a point where it can supplement coal and water-power. Intensive and unhampered research by scientists and industrial companies should be encouraged. Since the cost of fuel in this country is only about one-fifth of the total cost of generating electricity, no revolutionary reduction in cost could be expected even if atomic power should become cheaper than coal.

It is true that if all thought of application of atomic power for useful purposes were abandoned there would be no upset in our present economic system and the control of atomic bombs for military purposes would be greatly simplified. Yet it would be a pity if man should have to deny himself important resources which nature has given him—simply because he can not find a way to eliminate war and the causes of war.

Resolutions Request Cessation of Bomb Production

The Executive Committee of the **Amer[...] ican Association for the United Natio[...]** (Chairman: Dr. William Emerson, dire[...] tor: Clark M. Eichelberger) has release[...] a statement which urges, among othe[...] political measures, the cessation of stoc[...] piling of atomic bombs, and admission [...] representatives of the UNO Atomic E[...] ergy Commission to the forthcoming N[...] vy tests.

The **Federal Council of Churches [...] Christ** representing 25 million Protes[...] ant churchgoers, met at Columbus, Ohi[...] under the chairmanship of Bishop Bron[...] ley Oxnam, and adopted a resolution r[...] gretting the use of atomic bombs on Ja[...] anese cities and asking that Hiroshim[...] and Nagasaki be rebuilt by the America[...] people as a sign of repentance and go[...] will. This resolution was later severel[...] criticized in the press by a group [...] participants.

The Council also resolved to urge th[...] immediate cessation of atomic bomb pr[...] duction by the Army—this despite a tel[...] gram from Dr. A. H. Compton, who i[...] sisted that it is the duty of America [...] arm both for its own security and f[...] that of smaller nations unable to prote[...] themselves.

ROLLINS COLLEGE CONFERENCE

A conference to "discuss and recom[...] mend the formation of a type of wor[...] government adequate for the control [...] atomic bombs and other super-weapon[...] started on March 11 at Rollins College [...] Winter Park, Florida. It will contin[...] through March 15.

Participating were Profs. Samuel [...] Allison and Harold C. Urey of the Ins[...] tute of Nuclear Studies, University [...] Chicago; I. I. Rabi of Columbia Unive[...] sity, and Henry D. Smyth of Princet[...] University; the Rev. E. A. Conway, S. [...] of the Catholic Association for Intern[...] tional Peace; Rabbi Louis L. Mann [...] Chicago; W. T. Holliday, president of t[...] Standard Oil Company of Ohio; Carl V[...] Doren; Prof. Preston Slosson of the U[...] versity of Michigan; James Carey, se[...] retary-treasurer of the Congress of I[...] dustrial Organizations, and Emery Rev[...] author.

ITISH FOREIGN POLICY AND THE BOMB

e possibility of a reorientation of sh foreign policy in the event of a mate in the UNO discussions on the national control of the atomic bomb timated by two articles in **The Polit- Quarterly** (Jan.-March 1946, vol. No.1). **The Political Quarterly** is the important British journal devoted to discussion of political affairs from the ur and Liberal standpoints. The Edi- s Leonard Woolf, Secretary of the ur Party's Advisory Committee on nial and Imperial questions and one he Party's elder statesmen.

e two articles are by Leonard Woolf itain in the Atomic Age") and Rich- I. S. Crossman ("Britain and Western pe"). Both authors start from the ise that Britain would be indefensible atomic bomb war. Woolf says "Ten ic bombs would be sufficient to wipe on off the map. With that fact in and a map of Great Britain, it is not ılt to see that no country in the world re vulnerable than Britain to the new on. The concentration of our popula- in great industrial cities and our lity to live unless we keep our ports and working, mean that the whole ry would be virtually wiped off the within a week if we were combatants European war waged with that weap- Crossman is equally explicit: "How- courageous we showed ourselves, the world war would bring with it in its week the destruction of the Capital e Commonwealth and of the ports gh which we receive our food."

. Woolf was a vigorous proponent of League of Nations and he still re- s completely free of any taint of nalism or imperialism. But he is al of Mr. Bevin's view that "all that has to do is to go on building the d Nations Organization." "The atom- mb has made the UNO as developed umbarton Oaks and San Francisco, f date, antediluvian." As long as there chance, according to Mr. Woolf, for ggressor nation to obtain atomic s, then so much destruction could be ght that the retaliatory powers of est of the UNO would do little more add to the holocaust. "It follows that ng can save civilization if the exist- nternational system of sovereign na- states continues, for its destruction evitable if any sovereign state re- s free to manufacture, arm itself and he atomic bomb." There is little hope the bomb could be outlawed effective- States, or rather men politically, are arbarous that if governments can facture and possess these bombs, will manufacture and possess and ately use them. International control tional use of atomic energy, if it is limited to international inspection to see that atomic energy is not used for military purposes and the manufacture of military weapons, cannot be effective." From this Mr. Woolf concludes that the production of atomic energy must be in the hands of a world authority and that furthermore, all other major weapons must also be in the hands of a similar authority. This in turn might entail restriction of national sovereignty with respect to economic development. Mr. Woolf does not shrink from this prospect.

So far, Mr. Woolf's line of argument follows the Bevin-Eden statements for world government of November 22-23, 1945. But suppose the world government cannot be established? Mr. Woolf does not discuss the alternative and it is at this point that Mr. Crossman takes over the discussion. Mr. Crossman is about a generation younger than Mr. Woolf, but he continues in the same intellectual tradition of British Socialism; he is a political scientist and philosopher on the faculty of Oxford University, he is now MP for Coventry, and member of the Anglo-American Palestine Commission, Assistant Editor of **The New Statesman and the Nation** and on the Editorial Board of **The Political Quarterly.** During the war he held an important post connected with the Foreign Office and he must be regarded as the most outstanding specialist on Foreign Affairs among the new Labour MP's. His views are listened to with respect and endorsement by the vigorous group of Labour back-benchers who often dissent from the policies of the Government and who are likely to increase their influence in the Government in the near future.

Mr. Crossman has less optimism about world government than Mr. Woolf, and starting from the military premises already quoted, he proceeds to the conclusion that Britain's solution is to be found in a Western European Union. He carefully insists that it would not be anti-Soviet nor would it be dominated by Britain. It would be a union for economic collaboration. He also takes pains to make clear that it would not depend on American armed might. (The desire for British independence from American foreign policy is widespread in his group.) "Indeed," Crossman says, "if it is to gain both British and American confidence, its members must make clear that they would be neutral in any third world war, whatever the cost to British declaration of neutrality in event of a Soviet-American conflict has already been proposed in the **New Statesman and Nation.** As one Labour party intellectual humorously describing the incipient British trend toward neutrality said: "When the U.S. & Russia go to war, Britain will offer America all aid short of war."

Such a Western European union would be a far cry from Mr. Churchill's Anglo-American Association—it would be a break-up in the present loosely knit strategic Alliance between the United States and Great Britain. At present the demand for a neutralized Western Union is still small in the top order of the Labour Party but it is both considerable and increasing among Labour back benchers. An intensification of the threat of war with Soviet Russia is likely to cause an increase in it, and, this attitude might become a significant factor in British foreign policy.

E. S.

Moral Responsibilities of Scientists

(Continued from page 3)

achieve it only the future can show, but it is worth trying. It will not make headlines in the papers: immorality alas, not morality, is 'news'. Those who fancy themselves as hardboiled realists, as the 'practical men' who practice the errors of their forefathers, may deride us and our principles. But the truest form of realism is to recognize that human well being, indeed the continued existence of human society, depends more on improvement of morality and reasonableness than on invention of machinery or organization. We scientists, few and insignificant as we may be, have provided mankind with the knowledge and the tools, physical and biological, either for mutual destruction and elimination, or for an improvement in health, welfare and happiness beyond all previous experience. Let us try to supply, by our example, a common standard of ethical behavior and of courageous insistence on collaboration, so that man can then decide, with his eyes open, which of those alternatives he will choose.

FIRST MEMBER OF THE UNO ATOMIC COMMISSION APPOINTED

Sir Alexander Cadogan, permanent Under Secretary of the British Foreign Office and Britain's representative on the UNO Security Council, has been appointed to represent Britain on the Atomic Energy Commission. As his alternate, the British Government has appointed Sir James Chadwick, the discoverer of the neutron.

We hope that other nations will follow Britain's example in giving representation on the UNO Atomic Energy Commission to scientists.

The American delegate to this Commission has not yet been appointed.

The Bulletin of the Atomic Scientists

The title of this publication has been altered to **The Bulletin of the Atomic Scientists.** It previously was called **The Bulletin of the Atomic Scientists of Chicago.** The change is in response to recommendations made to the ASC from other site groups. It corresponds to the increasingly broad nature of the contents of, and the wider geographical distribution of the contributors to, the Bulletin. Editorship and sponsorship remain unaltered.

The Bulletin is now on a subscription basis—one dollar for six months; two dollars a year. Further financial aid towards improving the content, format and distribution is welcomed.

The space expansion in the Bulletin has been from 6 to 16 pages in seven issues; the distribution has increased by a factor of twenty in the first six issues.

The editors invite suggestions and comments. Contributed articles should be addressed to H. H. Goldsmith, Atomic Scientists of Chicago, 1126 E. 59 St., Chicago 37, Ill.

NOTES ON CONTRIBUTORS

H. A. Bethe is Prof. of Physics at Cornell University. He directed the work in theoretical physics at Los Alamos during the war.

E. U. Condon is President of the American Physical Society, Director of the Bureau of Standards, and Scientific Adviser to the Senate Special Committee on Atomic Energy.

Farrington Daniels is Prof. of Chemistry at the University of Wisconsin and Director of the Metallurgical Laboratory at the University of Chicago.

S. A. Goudsmit is Prof. of Physics at the University of Michigan. Associated with the Radiation Laboratory at M.I.T. during the war, he led a scientific mission which studied the German atomic energy program.

A. V. Hill is one of the world's leading physiologists and past-president of the Royal Society.

James T. Shotwell is Chairman of the Carnegie Endowment for International Peace.

CIVILIAN VS. MILITARY CONTROL

(Continued from page 1)

such actions or proposed actions of the commission to the President, whose decisions shall be final."

Senator Vandenberg claims that this proposal leaves all power with the civilian Commission, and merely allows the military to interfere whenever it feels that the interests of national defense are threatened by action (or inaction) of the Commission. When President Truman, on March 13 confirmed his support for civilian control as envisaged in the McMahon bill, but added that "the military had an important part to play and should be consulted"—Senator Vandenberg said that that describes his proposal "exactly." Why then are the proponents of civilian control still alarmed? Why did Senator Millikan vote for Vandenberg's proposal and Senator McMahon against it, and not the other way around?

The answer is that Vandenberg's proposal leaves it up to the military board to determine what is of concern to "national defense and security." This gives it the right—or rather, the duty—to try to impose its concept of security upon as wide an area of fundamental research as possible. In other words, the military advisory board is certain to attempt a continuation of the Manhattan District policy of secrecy and compartmentalization.

The reason why a military board cannot but try to carve out the largest possible chunk out of the living body of science, is because they don't understand it, and therefore have to "play safe." How can they know what field of nuclear research (or any other branch of natural science) is "important for national defense?" After all, it was not the military who first guessed the explosive potentialities of atomic fission in 1939!

Nations are accustomed to looking to their military men whenever their security is endangered. The revolutionary fact of the present situation is that military have ceased to be experts on security. In fact, they can offer no security. Some of them — like General Arnold — freely acknowledge it. But the spokesmen of the Army and Navy do not feel like coming to the Congress and saying: "You have entrusted us with guarding the security of the American nation. We have to return the mandate, because we cannot fulfil it. There is no security for a nation in the world of atomic armaments." Instead, they proclaim themselves guardians of secrets in which fictitious security is supposed to reside. This is the dangerou delusion which the scientists are fightin when they oppose the apparently innoce right of the military to "advise and co sult" with the Atomic Energy Commissio

The testimony of the Federation Atomic Scientists before the McMah Committee, presented on January 2 clearly stated that the scientists "do n exclude efficient liaison between the Ator ic Energy Commission and the militar Provision to make this liaison mandato will not be opposed by them." Neither the scientists object to the Army unde taking research and development of atom ordnance. But they do oppose the exte sion of Army control into the field fundamental science under the pretext guarding "secrets vital for national s curity." It was Secretary of War Patte son himself who stated before the M Mahon Committee that the military a not competent to draw the line betwe basic research and its military applic tions, and that this is one of the poli decisions which must be left entirely the hands of the Civilian Commission

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BULLETIN OF THE ATOMIC SCIENTISTS

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LETIN of the
ATOMIC SCIENTISTS . . . .

L. I APRIL 1, 1946 No. 8

lans For International ontrol Take Shape

In this issue, we reprint in condensed form, a very important document—the report e State Department Committee on Atomic Energy. Its publication must be hailed cientists, and by all who see in the international control of atomic energy the only for prevention of an atomic war, as the first step towards this great goal. This is hasized in an article by Prof. Teller and by the comments of Prof. Urey printed else- e in this issue. We hope that the State Dept. report will be widely read, studied and mented upon.

As a contribution towards the discussion, invited by the Secretary of State, we print in this issue a Draft Convention prepared at Chicago by a group of scientists r the leadership of Professor Quincy Wright.

The State Department report is a broad and eloquent presentation of a definite se of action. The Chicago document is couched in a more legalistic language, and s in considerable detail the administrative set-up of the proposed international cy. However, scrutiny of the basic policies proposed in the two documents—which been prepared entirely independently from each other—reveals remarkable similar- n many important points.

The State Department report proposes an Atomic Development Authority, which have a monopoly in mining and refining of uranium and thorium, and in producing separating uranium 235 and plutonium. The same authority will also carry out arch in nuclear physics, and license and inspect national and private activities in ield. National or private agencies will be permitted to carry out only small-scale ations which cannot lead to the production of atomic weapons. Large power plants recognized as more "dangerous," but it is suggested that imposition of certain gns and "denaturation" of materials may permit the operation of such plants by nal or private agencies subject to license from and inspection by the ADA. How- it is pointed out that since power piles will require considerable quantities of nable materials, which will first have to be produced in international plants, the lem of licensing such piles will not become acute for several years.

The Chicago plan, too, provides for an international atomic energy agency with ive and not merely policing functions. It is suggested that this Agency should ist of an Atomic Energy Commission for the determination and revision of funda- al policies, and of two commissions of experts. The first one, referred to as the inistrative Commission, will carry out research, and produce and distribute fission- materials for small-scale experimental or medical activities. No private or nal production or ownership of fissionable material will be permitted.

The other commission of experts is an Inspection Commission (the State Depart- committee emphasizes that development and inspection shall be put in the same s). Because of the similarity of general policies, the type of inspection required be about the same in both plans.

The control of mining is less comprehensive in the Chicago draft. Only those s which are major sources of uranium and thorium are to be owned or operated by Commission; the less important mines may be licensed for private operation.

The problem of power piles is solved in the Chicago draft temporarily by a five-year torium, during which only experimental power installations may be built by the rnational Board of Nuclear Studies. After five years, the problem shall be re- ined. If the construction of power piles is permitted at that time, it will have decided whether they should be operated by the international Commission, or could censed for private or national operation.

During the same five years the Chicago draft also proposes an interruption of scale production of fissionable materials, with the American plants in a stand-by ition. The State Department report envisages no such interruption. In fact, oks forward to the construction and operation, under the auspices of the Atomic elopment Authority, of additional production plants in various countries.

Current Status of Domestic Legislation

An Amendment is Amended

The struggle over the domestic legislation on atomic energy has focussed itself on the so-called Vandenberg amendment to the McMahon bill. This amendment, whose original text was reprinted in our last issue, provides for a military liaison board with whom the civilian Atomic Energy Commission is instructed to "advise and consult" on matters of policy.

What caused all proponents of military rule to rally behind this amendment and induced all defenders of civilian authority to rise up in opposition, were the provisions which made the military board in fact an equal in status if not a superior to the civilian Atomic Energy Commission.

The outburst of protest, with which the adoption of the original Vandenberg amendment by a 10:1 vote was greeted by numerous scientific and lay organizations and individuals, appears to have surprised its sponsor. Vandenberg pleaded that he was in favor of civilian control and did not see why his amendment was inconsistent with this principle; but his opponents felt that the subtle and indirect way in which this amendment introduced military supervision, while preserving the fiction of civilian authority, was even more dangerous than the attempts to establish an outright military rule.

The fight against the Vandenberg amendment has rapidly assumed the character of a major national issue. An Emergency Conference of Organizations favoring civilian control was organized in Washington on March 22 and soon included about ninety organizations of widely different character — most of them nation-wide — from the CIO to the American Bar Association, and from the Independent Citizen Committee to the Military Order of the Purple Heart.

In addition, a National Committee of individuals came into being at Washington on March 28. Invitations were sent by Donald Nelson, the former WPB chief, and the response was almost unanimously positive. The list of names on the National Committee, includes many prominent people of different political and social

(Continued on page 19)

State Dep't Report on the Control of Atomic Energy

From the FOREWORD
By the Secretary of State

The intensive work which this document reflects and the high qualifications of the men who were concerned with it make it a paper of unusual importance and a suitable starting point for the informed public discussion, which is one of the essential factors in developing sound policy. The document is being made public not as a statement of policy but solely as a basis for such discussion.

From the LETTER OF TRANSMITTAL
to The Secretary of State by The Commission

Dear Mr. Secretary:

On January 23, 1946, we appointed as a Board of Consultants:

Mr. David E. Lilienthal, Chairman of the Tennessee Valley Authority, who acted as Chairman,

Mr. Chester I. Barnard, President of the New Jersey Bell Telephone Company,

Dr. J. Robert Oppenheimer, of the California Institute of Technology and the University of California,

Dr. Charles Allen Thomas, Vice President and Technical Director, Monsanto Chemical Company, and

Mr. Harry A. Winne, Vice-President in Charge of Engineering Policy, General Electric Company.

The Board of Consultants has now completed its report.

We lay the report before you as the Board has submitted it to us, "not as a final plan, but as a place to begin, a foundation on which to build." In our opinion it furnishes the most constructive analysis of the question of international control we have seen, and a definitely hopeful approach to a solution of the entire problem. We recommend it for your consideration as representing the framework within which the best prospects for both security and development of atomic energy for peaceful purposes may be found.

In particular, we are impressed by the great advantages of an international agency with affirmative functions coupled with powers of inspection in contrast to any agency with merely police-like powers, attempting to cope with national agencies otherwise restrained only by a commitment to "outlaw" the use of atomic energy for war.

We wish to stress two matters. The first concerns the disclosure of information. The report permits of the disclosure by progressive stages. Certain information, required for an understanding of the workability of proposals, would have to be made available at the time of the discussions of the proposals in the United Nations Atomic Energy Commission. We estimate the effect of its disclosure to be as follows: If made known to a nation otherwise equipped by industrial development, scientific resources, and possessing the necessary raw materials to develop atomic armament within five years, such disclosure might shorten that period by as much as a year. If the program were spread over a considerably longer period, the disclosure referred to would not shorten the effort appreciably.

The next stage of disclosure might occur when the proposed international organization was actually established. At this time the organization would require most of the remaining scientific knowledge, but would not require the so-called technical know-how or the knowledge of the construction of the bomb.

By the time the organization was ready to assume its functions in the field of industrial production it would, of course, require the technological information and know-how necessary to carry out its task. The information regarding the construction of the bomb would not be essential to the plan until the last stage, when the organization was prepared to assume responsibility for research in the field of explosives as an adjunct to its regulatory and operational duties.

The second matter relates to the transfer of authority over physical things. Here also the plan permits of progress by stages, beginning in the field of raw material production progressing to that of industrial production, and going on to the control of explosives.

The development of detailed proposals will be guided, of course, by basic decisions of high policy. One of these decisions will be for what period of time the United States will continue the manufacture of bombs. The plan does not require that the United States shall discontinue such manufacture, either upon the proposal of the plan or upon the inauguration of the international agency. That decision, whenever made, will involve considerations of the highest policy affecting our security, and must be made by our government under its constitutional processes and in the light of all the facts of the world situation.

DEAN ACHESON, Chairman, VANNEVAR BUSH, JAMES B. CONANT, LESLIE R. GROVES, JOHN J. McCLOY

FOREWORD

Since February 25th this board has met almost continuously, developing the following report. Our absorption in this task is a measure of how important and urgent we feel it to be that the Government and the people of the United States develop a rational and workable plan, before the already launched international atomic armament race attains such momentum that it cannot be stopped.

We have concluded our deliberations with a measure of confidence. It is worth contrasting the sense of hope which all of us share today with the feeling which we had at the outset. The vast difficulties of the problem were oppressive, and we early concluded that the most we could do would be to suggest various alternative proposals. But as we steeped ourselves in the facts and caught a feel of the nature of the problem, we became more hopeful. Five men of widely differing backgrounds and experience, who were far apart at the outset, found themselves, at the end of a month's absorption in this problem, not only in complete agreement that a plan could be devised but also in agreement on the essentials [of] a plan.

Section I
BACKGROUND OF THE PROBLEM

We were given as our starting point a political comm[it]ment already made by the United States to bring about int[er]national arrangements to prevent the use of atomic ene[rgy] for destructive purposes. The Agreed Declaration of N[o]vember 15, 1945, issued by the President of the United Sta[tes] and the Prime Ministers of the United Kingdom and Cana[da] recognizes that the development of atomic energy has pla[ced] at the disposal of mankind "means of destruction hithe[rto] unknown;" that there can be no adequate military defe[nse] against atomic weapons and that these are weapons "in [the] employment of which no single nation can have a monopol[y]." Strong arguments have been brought forward that the m[ass] of technical and scientific knowledge and experience nee[ded] for the successful development of atomic weapons is so gr[eat] that the results attained in the United States cannot be par[al]leled by independent work in other nations. These argume[nts] have been met with great and widespread skepticism. It

gnized that the basic science on which the release of nic energy rests is a world-wide science; and that the in-ry required for the realization of atomic weapons is the e industry which plays so essential a part in man's uni-al striving to improve his standard of living and his con- of nature. It is further recognized that atomic energy s so vital a part in contributing to the military power, to the possible economic welfare of a nation, that the ntive to other nations to press their own developments is whelming.

There are perhaps other considerations which have con-ted to the popular understanding of the necessity for rnational control. Our political institutions, and the his-cally established reluctance of the United States to take initiative in aggressive warfare, both would seem to put t a disadvantage with regard to surprise use of atomic pons. This suggests that although our present position, hich we have a monopoly of these weapons, may appear ng, the situation may be reversed in a world in which nic armament is general.

When the news of the atomic bomb first came to the world e was an immediate reaction that a weapon of such devas-g force must somehow be eliminated from warfare; or se the common expression, that it must be "outlawed". fear of surprise violation will surely break down any dence if the treaty obligations and good faith are the assurances upon which to rely.

uch considerations have led to a preoccupation with sys- of inspection by an international agency to forestall and t evasions of agreements not to use atomic weapons. ur own inquiry we began at this point, and studied in e detail the factors which would be involved in an inter-nal inspection system. We have concluded that there is rospect of security against atomic warfare in international ements controlled **only** by inspection and similar police-methods.

Ve do not underestimate the need for inspection as a ponent, and a vital one, in any system of safeguards, but ave been concerned with discovering what other measures equired in order that inspection might be so limited that uld be practical.

TECHNICAL AND HUMAN PROBLEMS OF PECTION

he general purpose of inspection as the sole safeguard d be to assure observance of international agreements rding to which national activities leading to atomic ar-ent would be renounced, and others which have as their ose peaceful applications of atomic energy would be per-d. The fact that in much of their course these two types tivity are identical, or nearly identical, makes the prob-one of peculiar difficulty.

our study of systems of inspection, we were greatly by consultations with the Technical Committee report-o the War Department on the technical aspects of the ction problem. As a result of our work with this Com-e, we are clear: that every stage in the activity, leading raw materials to weapon, needs some sort of control, that this must be exercised on all of the various paths may lead from one to the other; that at no single point xternal control of an operation be sufficiently reliable to adequate sole safeguard; and that, for effective control, ontrolling organization must be as thoroughly informed the operation as are the operators themselves. We be- that an examination of these and other necessary pre-tions for a successful scheme of inspection will reveal **they cannot be fulfilled in any organizational arrangement ich the only instrument of control is inspection.**

fundamental objection to an agency charged solely with ction is that it will inevitably be slow to take into account changes in the science and technology of the field. In a field as new and as subject to technical variation and change as this, the controlling agency must be at least as inventive and at least as well informed as any agency which may attempt to evade control.

Even more important than the technical difficulties are the many human factors which in such an arrangement would tend to destroy the confidence and the cooperation essential to its success. The work which would be largely policing and auditing and attempting to discover evidences of bad faith, would not be attractive to the type of personnel essential for the job.

The presence of a large number of "foreigners" necessarily having special privileges and immunities, inquiring intimately and generally into industrial and mining operations would be attended by serious frictions. They would have to check not merely accounts and measuring instruments but also individuals personally. Industrial secrets would be at least to some extent open to "prying". This would probably be as obnoxious to Americans as to any others. The corrosive effect upon the morale and loyalty of the inspecting organization would be serious.

Adequate surveillance by inspection as the sole means of control involves a persistent challenge of the good faith of the nations inspected. Official questioning of the good faith of a nation would tend to produce internal as well as external political problems.

Some may question whether nations would possess strong incentives to illicit operations, if they actually agreed to forego the use of fissionable materials for purposes of war. It is obvious, however, that suspicion by one nation of the good faith of another and the fear engendered thereby are themselves strong incentives for the first to embark on illicit operations. The raw materials of atomic energy are already a matter of extreme competition between nations. The forces growing out of this situation and making for acute rivalry between nations seem to be far more powerful than those which cause the present rivalries with respect to such resources as oil. The efforts that individual states are bound to make to increase their industrial capacity and build a reserve for military potentialities will inevitably undermine any system of safeguards which permits these fundamental causes of rivalry to exist.

Section II
PRINCIPAL CONSIDERATIONS IN DEVELOPING A SYSTEM OF SAFEGUARDS

As we proceeded with our study we were inescapably driven to two conclusions: (a) the facts preclude any reasonable reliance upon inspection as the primary safeguard against violations; (b) the facts suggest quite clearly a reasonable and workable system that may provide security, and even beyond security, foster beneficial uses of atomic energy.

It may be helpful to summarize the characteristics that are essential to an effective system of safeguards.

a. Such a plan must reduce to manageable proportions the problem of enforcement of an international policy against atomic warfare.

b. It must be a plan that provides unambiguous and reliable danger signals if a nation takes steps that do or may lead to atomic warfare.

c. The plan must be such that if it fails or the whole international situation collapses, any nation such as the United States will still be in a relatively secure position.

d. To be genuinely effective, the plan must be not wholly negative. It must tend to develop the beneficial possibilities of atomic energy and encourage the growth of fundamental

knowledge, stirring the constructive and imaginative impulses of men rather than merely concentrating on the defensive and negative.

e. The plan must be able to cope with new dangers that may appear in the further development of this relatively new field. In an organizational sense therefore the plan must have flexibility.

f. The plan must involve international action and minimize rivalry between nations in the dangerous aspects of atomic development.

THE PROBLEM HAS DEFINABLE BOUNDARIES

The only scientific evidence worthy of regard makes it clear that uranium is indispensable in the production of fissionable material on a scale large enough to make explosives or power.

Uranium is the only natural substance that can maintain a chain reaction. It is the key to all foreseeable applications of atomic energy. Thorium cannot maintain a chain reaction, either itself or in combination with any natural material other than uranium. However, with a fairly substantial amount of uranium to begin with and suitably large quantities of thorium a chain reaction can be established to manufacture an atomic explosive which can also be used for the maintenance of other chain reactions.

Absolute control of uranium would therefore mean adequate safeguard regarding raw materials. Yet, since any substantial leakage of uranium through the system of controls would make possible the exploitation of thorium to produce atomic explosive, provisions governing thorium should be incorporated in the system to compensate for possible margins of error in the control of uranium.

The control problem is further narrowed by the geological conditions under which uranium and thorium are found, and the fact that at present those elements have only a restricted commercial significance. It is apparently the view of the authorities that these elements occur in high concentrations only under very special geologic conditions. This would seem to mean that the areas which need to be surveyed, to which access must be had, and which would ultimately have to be brought under control, are relatively limited.

CONSTRUCTIVE APPLICATIONS OF ATOMIC ENERGY

If atomic energy had only its horrible powers of destruction, the incentive to complete suppression might be very great. We have concluded that the beneficial possibilities in the use of atomic energy should be and can be made to aid in the development of a reasonably successful system of security, and the plan we recommend is predicated on that idea.

The difficulty of recruiting enforcement officers having only a function of prohibiting, detecting, and suppressing, is obvious. Such a job does not appeal to the imagination. Its future opportunities are obviously circumscribed. It might draw the kind of man, let us say, who was attracted to prohibition squads in years past. Compare this type of personnel with those who could be expected to enter a system under which constructive possibilities of atomic energy may also be developed. Atomic energy then becomes a new and creative field in which men may take pride as participants.

What are the beneficial possibilities? We had the benefit of a report prepared for the Secretary of War's Interim Committee on Atomic Energy by a panel of scientists. The report discusses two "great fields" for beneficial use, "the development of atomic energy as a controlled source of power" and "the application of radiations and radioactivities to the growth of the sciences and the practical arts." "It is probable," the report states, "that the exploitation of atomic energy a tool for research will outweigh the benefits to be deriv from the availability of a new source of power." The prospe of a plentiful supply of radio-active substances may well as significant for scientific progress as the ready availabili of microscopes for every laboratory.

We believe that only a system of safeguards which is bu around these hopeful prospects can succeed. We have tri throughout this report to make explicit the connection tween a system of safeguards and these opportunities.

Important in the proposals we put forth in this report the fact that many of the constructive activities involve risks of providing a material basis for weapons of war.

THE ELIMINATION OF INTERNATIONAL RIVALRY

It is clear that uranium and thorium are materials of gre strategic importance. The fact that rich sources of such m terials occur in a relatively few places in the world, as co pared for example with oil, creates a competitive situati which might easily produce intolerable tensions in internation relations. We believe that so long as nations or their subje engage in competition in the fields of atomic energy hazards of atomic warfare are very great indeed.

What is true in respect to the dangers from national co petition for uranium is similarly true concerning other pha of the development of atomic energy. Assume an internatio agreement barring use of the plutonium in a bomb, but p mitting use of the plutonium pile for heat or power. No syst of inspection, we have concluded, could afford any reasona security against the diversion of material to the purpo of war. If nations may engage in this dangerous field, **the v existence of the prohibition** against the use of such piles produce fissionable material suitable for bombs would t to stimulate evasions. If, however, the element of riva between nations were removed by assignment of the intri cally dangerous phases of the development of atomic ene to an international organization, a prospect would be affor for a system of security. For it is the element of rivalry the impossibility of policing the resulting competition t make inspection unworkable as a sole means of control. W that factor of international rivalry removed, the problem comes both hopeful and manageable.

(a) Take the case of uranium ores. If any nation r engage in prospecting for and mining uranium ore, sub to inspection as to the proper use thereof, inspection is a n difficult thing. But if the **only legal ownership and developm of uranium ore** is in the hands of an international agency problem of detection of evasions is reduced tremendously. then it would be true that not the purpose of those who n or possess uranium ore but the **mere fact of their mining possessing it** becomes illegal, and national violation is an ambiguous danger signal of warlike purposes.

(b) Take another illustration involving the building operation of a plutonium pile. The product of that opera can be used for atomic weapons. It is also useful for po piles. If such piles are designed and operated exclusively an international agency, then the building of such a pil any move in that direction by **anyone else** is illegal wit respect to the use he says he plans to make of it, and stitutes a plain danger signal. Nor could there be a cle sign of danger, calling for immediate international ac than interference with the operation of an international p

There is a further advantage to vesting exclusively i international agency these activities so hazardous to w security. This is a growing and changing field. If the i national agency is simply a police activity for only nega and repressive functions, inevitably and within a very s period of time the enforcement agency will **not know en** to be able to recognize new elements of danger.

The art of atomic weapons is in its infancy and we are e ignorant of the possibilities in this field. Such ignorance tself a source of danger, and its continuation, through the nibition of further study and development, would in our nion not only be hard to effect, but would itself be danger- Yet the development of atomic weapons can hardly be to national rivalry.

further example: The present separation plants for U 235 Oak Ridge are huge and bulky in the extreme. Quite prob- this will always be true. But it is not a law of nature. se in whose hands lies the prevention of atomic warfare t be the first to know and to exploit technical advances his field.

We have, therefore, concluded that here was an additional on and a very practical one why a responsibility for the lopment of atomic energy should be vested in the same rnational agency that has also responsibility for develop- and enforcing safeguards against atomic warfare. For ss the international agency was engaged in development vities itself, its personnel would not have the power of vledge or the sensitivity to new developments that would e it a competent and useful protection to the people of world.

We have therefore reached these two conclusions: (a) that if the dangerous aspects of atomic energy are taken out ational hands and placed in international hands is there reasonable prospect of devising safeguards against the of atomic energy for bombs, and (b) only if the inter- onal agency was engaged in development and operation l it possibly discharge adequately its functions as a safe- der of the world's future.

FE" AND "DANGEROUS" ACTIVITIES

f it were necessary to vest in an international agency a monopoly as to all aspects of atomic energy, disadvantages d arise so great as conceivably to make the prospect of tive internationalization itself beyond realization. Such verall grant of exclusive right to develop, operate, and e, conferred upon an international agency, would change of the industrial and economic practices of this country, xample, and would change them quite disadvantageously.

his problem need not arise. For there are important areas e field of atomic energy where work may and should be to private and to national institutions. These fields are e greatest immediate promise for the beneficial exploita- of atomic energy. That open and, in some respects, com- ve activity is possible in much of the field should go a way toward insuring contact between the experts of nternational organization and those outside it, and aid oviding healthy, expanding national and private develop- s in atomic energy.

word may be in order about our views on what constitute gerous activities". It will be appreciated at the outset the distinction between the "safe" and the "dangerous" be useful without being completely sharp or fixed for all

our view, any activity is dangerous which offers a solu- either in the actual fact of its physical installation, or by e alterations thereof, to one of the three major problems aking atomic weapons:

I. The provision of raw materials,

I. The production in suitable quality and quantity of the fissionable materials, plutonium and U 235, and

I. The use of these materials for the making of atomic weapons.

us we regard the mining and processing of uranium dangerous activity even though it must be supplemented ants and ordnance establishments if atomic weapons are ult. We regard the facilities for making atomic weapons as dangerous even though some control be exercised over the production of the fissionable material; and we regard the operation of reactors or separation plants which make the material for bombs or which, by relatively minor operational changes, could make the material for bombs, as dangerous even though they in turn would have to be supplemented by supplies of raw material and by installations for assembling atomic weapons.

We need not regard as dangerous either amounts of material which are small in relation to those needed to make a weapon or installations whose rate of production is small in these terms. A further point which will prove important is this: U 235 and plutonium can be denatured; such denatured materials do not readily lend themselves to the making of atomic explosives, but they can still be used with no essential loss of effectiveness in reactors for the generation of power or the production of radioactive tracers. Denaturing will make the material unuseable by any methods we now know for effective atomic explosives, unless steps are taken to remove the denaturants. It is possible, both for U 235 and for plutonium, to remove the denaturant, but doing so calls for installations which, though not of the scale of those at Oak Ridge or Hanford, nevertheless will require a large effort and, above all, scientific and engineering skill of an appreciable order.

Although as the art now stands, denatured materials are unsuitable for bomb manufacture, developments which do not appear to be in principle impossible might alter the situation. This is a good example of the need for constant reconsideration of the dividing line between what is safe and what is dangerous.

We would propose as criterion that installations using material both denatured and insufficient in quantity for the manufacture of bombs could be regarded as safe, provided the installations did not themselves make large quantities of suitable material. With some safeguards in the form of supervision, installations in which the amounts of material are small, or in which the material is denatured, might also be regarded as safe; but installations using or making large amounts of material not denatured, or not necessarily denatured, we would call dangerous.

Let us see now what we regard as safe activities in this field.

(1) Perhaps the clearest case is the application of radioactive material as tracers in scientific, medical, and technological studies. We can see no reason at all for limiting, on grounds of safety, the activities using such tracer materials.

(2) Small nuclear reactors which use denatured U 235 or plutonium can be operated at a power level low enough to be incapable of producing dangerous quantities of fissionable materials, but high enough to provide neutron sources and gamma ray sources of unparalleled intensity. The material contained in these reactors is neither in quantity nor in quality significant for bomb production; even if one combined the material from many, no practical method of making weapons would be available. They operate at so low a power level that they cannot be used to produce quantities of fissionable material which are of military significance; but they can be used to make radioactive materials, and as such may be a valuable supplement to "dangerous" reactors operating at higher power levels; in particular, they can make useful radioactive materials that last too short a time to permit them to be provided from remote plants. As a source of radiation, primarily of neutron radiation, such reactors are important research tools for physics, chemistry, and biology. The high intensity of radiation provided by them will bring about changes in chemical and biological systems which may be of immense practical value, once they have been understood.

(3) More marginal from the standpoint of safety, is the development of power from denatured U 235 and plutonium in high power-level reactors (in the range from 100,000 to 1,000,000 kw). If these materials are used in installations where there is no additional uranium or thorium, they will not produce further fissionable material. The operation of the reactors will use up the material. If the reactors are suitably designed, a minimum of supervision should make it possible to prevent the substitution of uranium and thorium for the inert structure of the reactors. In order to convert the material invested in such reactors to atomic weapons, it would be necessary to close down the reactor; to decontaminate the fissionable material of its radioactive fission products; to separate it, in what is a fairly major technical undertaking, from its denaturant; and to establish plants for making atomic weapons. In view of the limited amount of material needed for such a power reactor, and of the difficulty of the steps necessary to divert it, we would regard such power reactors as safe provided there were a reasonable supervision of their design, construction, and operation. If the material from one such reactor (of a size of practical interest for power production) were diverted, it might be a matter of some two or three years before it could be used to make a small number of atomic weapons.

Reactors of this type make it possible to open up the field of atomic power production to private or national enterprise. It is important to note that the materials required to construct these reactors cannot themselves be produced in installations which we regard as safe. For every kilowatt generated in the "safe" reactor, about one kilowatt will have to be generated in "dangerous" ones, in which the material was manufactured. Thus if atomic power is developed on a large scale, about half of it will be an international monopoly, and about a half might be available for competitive exploitation. That is to say, the primary production plants necessary to produce the materials required to construct safe power plants will produce large amounts of power as a by-product. Stockpiling of appreciable quantities of fissionable material, suitable, denatured, will have to precede the development of these safe power reactors. We think it fortunate that the operation of such reactors will have to await the production of these essential materials, so that there will be time for further study of means by which they may be supervised and their safety insured.

All the above illustrations show that a great part of the field of atomic energy can be opened with relative safety to competitive activity. They also show that the **"safe" operations are possible only because "dangerous" ones are being carried out concurrently.** It is not possible to devise an atomic energy program in which safeguards independent of the motivation of the operators preclude the manufacture of material for atomic weapons. But it is possible, once such operations are undertaken on an international basis, to devise others of great value in which safety is no longer dependent on the motivation of the operators.

We have enumerated elements of the large field of non-dangerous activities under (1), (2), and (3) above. Among the activities which we would classify as dangerous for national exploitation are the following:

(4) Prospecting, mining, and refining of uranium, and, to a lesser extent, thorium.

(5) The enrichment of the isotope 235 by any methods now known to us.

(6) The operation of the various types of reactors for making plutonium, and of separation plants for extracting the plutonium.

(7) Research and development in atomic explosives.

Of these activities, (6), as we have indicated, not on plays an essential part in providing active materials, but i volves installations capable of generating power.

To exclude even safe activities from international oper tion seems unwise, but these should not be an internation monopoly. It would equally be unwise to exclude from know edge and participation in the dangerous activities exper who are not associated with the international authority. the next section will show, there are practical means for maki this collaboration possible in such a way that security w be promoted rather than impaired.

Section III
SECURITY THROUGH INTERNATIONAL COOPERATIVE DEVELOPMENT

SUMMARY OF PROPOSED PLAN

The proposal contemplates an international agency w exclusive jurisdiction to conduct all intrinsically dangero operations in the field. This means all activities relating raw materials, the construction and operation of producti plants, and the conduct of research in explosives.

The international agency might take any one of seve forms, such as a UNO Commission, or an international corpo tion or authority. We shall refer to it as Atomic Developm Authority. It must have authority to own and lease proper and to carry on mining, manufacturing, research, licensi inspecting, selling, or any other necessary operations.

National activities in the field of research (except on plosives) and the construction and operation of non-danger power-producing piles would be subject to moderate contr by the international agency, exercised through licensing, ru and regulations, collaboration on design, and the like. international agency would also maintain inspection facili to assure that illicit operations were not occurring, prima in the exploitation of raw materials. It would be a furt function of the Atomic Development Authority continu to reexamine the boundary between dangerous and n dangerous activities. For although the field is subject reasonable division, the dividing line is not sharp and n shift from time to time in either direction.

The development agency itself would be truly internati in character. Its staff would be recruited on an internati basis. It would be set up as one of the subsidiary agen of the United Nations, but it would have to be created b convention or charter establishing its policies, functions, authority in comprehensive terms.

In its operations the development organization would governed by a dual purpose, the promotion of the benef use of atomic energy and the maintenance of security. believe that much can be done in a convention or cha to make these purposes concrete and explicit, to draw line between the dangerous and the non-dangerous, to es lish the principles determining the location of stockpiles plants so that a strategic balance may be maintained an nations, to establish fair and equitable financial policie that the contributions of nations to, and their receipt of b fits from the organization will be justly apportioned.

FUNCTIONS OF ATOMIC DEVELOPMENT AUTHORIT

The first purpose of the agency will be to control v **supplies of uranium and thorium.** Wherever these mate are found in useful quantities the agency must own them or control them under effective leasing arrangements. One o principal tasks will be to conduct surveys so that new dep will be found and so that the agency will have the most com knowledge of the world geology of these materials. It be a further function of the agency constantly to ex new methods for recovering these materials from medi which they are found in small quantities.

n this way there will be no lawful rivalry among nations these vital raw materials. Through its surveys the agency be better informed about their geology and extraction any single nation could possibly be. It will be in a er position to discover whether and where illicit operations nt occur than any inspection force could possibly be.

'he international agency would require access to various ons for its geologists and mining engineers. But the vn geology of the critical materials is such that it may ossible to limit the degree of access from the start. And, xplorations proceed and various areas are eliminated it be hoped that the need for access would narrow, rather expand, but at all times the right of access to any region re-survey in the light of new knowledge would be neces-

ll the actual mining operations for uranium and thorium d be conducted by the Authority. It would own the stock- of these materials and it would sell the by-products, as vanadium and radium. In the field of raw materials n other activities of the Authority, extremely difficult y questions, with the most serious social, economic, and ical implications, will arise. As between several possible s in different areas, which shall be operated when it is that the outputs of all is not presently required? How a strategic balance be maintained between nations so stockpiles of fissionable materials will not become unduly in one nation and small in another? We do not suggest these questions are simple but we believe that practical ers can be found.

roduction Plants — The second major function of the ority would be the construction and operation of atomic ors and separation plants. This means that operations, those at Hanford and Oak Ridge and their extensions improvements, would be owned and conducted by the ority. Reactors for producing plutonium will be large llations and will yield large amounts of energy as a by- ct. One of the first problems of the Authority would develop designs of reactors such that the energy re- d would be useable for the generation of electric power.

any questions suggest themselves in relation to such pro- on plants. How can the danger in design of plants and t be reduced? How can we assure the minimum danger version? How should plants be located so as to permit disposition of byproduct power and heat where they are needed and at the same time to maintain a strategic ce between nations, so that none may fear lest the ex- ce of plants in another would give that nation an advantage suddenly developed aggressive intentions? Here again ink that answers, although not easy, can be found.

esearch Activities — The Authority will have to engage wide variety of research activities. For example, it will to do research in atomic explosives. If it turns out, as ult of new discoveries, that other materials lend them- s to dangerous atomic developments, it is important that uthority should be the first to know. At that time meas- would have to be taken to extend the safeguards.

hile conducting its own necessary research, the Authority give vigorous encouragement to research in national ivate hands. The universities and public technical agencies, trial enterprises, research institutes, all will have a t interest in participating in these activities. The Au- ty will produce radioactive isotopes in primary production s. The chemical separation and purification of them, ver, is an involved industrial process, which constitutes reat to security; states or private organizations should couraged to go into these activities. For many purposes, l also be possible to produce these isotopes in small non- erous reactors. A deliberate effort should be made to rage the production of isotopes in national hands.

Licensing Activities — The uranium and thorium which the Authority mines and the fissionable materials which it produces will remain the property of the Authority. Through the lease of such denatured materials to those desiring to build and operate non-dangerous reactors, the personnel of the Authority could have access to the establishment in which such material is used.

One of the first licensing activities of the Authority might be in the field of research reactors for which it would furnish on lease denatured plutonium or U 235. Presumably those desiring to build such research reactors would submit their designs to the Authority both for approval and for advice, would obtain a license to build, and would lease the denatured fissionable material needed for it. Presumably the Authority from time to time would send its research personnel, in the dual role of research workers and inspectors, to the laboratories in which these reactors were used. Presumably licenses and leases of material would be arranged between the Authority and individual nations, so that the Authority would not be dealing directly with private groups within nations.

The Authority would also license and lease denatured materials for the construction and operation of reactors for making radioactive materials.

Within the next few years, the Authority should also be in a position to license the construction and operation and to furnish on lease denatured plutonium or U 235 for power piles. The design of such piles would have to be carefully reviewed, and the construction perhaps should be inspected by the Authority, to insure that the pile was not readily convertible to a dangerous form. For example, there should be no provision within such piles for the introduction of extra uranium or thorium. Iron or lead might be required as obligation structural materials; if these were made non-removable, there would be a large factor of safety against abuse. Such power reactors would "burn" the active materials and require replenishing from time to time. For several years there would not be enough fissionable materials produced in the plants of the Authority to stock such power piles. During this period research and development may proceed, as a result of which much more will be known as to the safe and unsafe features of design by the time when decisions will be required.

Inspection Activities — Inspection in a wide variety of forms has its proper place in the operations of the Atomic Development Authority.

In the inspection of declared and legal activities — the Atomic Development Authority will be in a position to insure that in the plan of operations, in the physical layout, in the system of audits, and in the choice of developments, full consideration can be given to the ease of detecting and avoiding diversion and evasion. In the location of its operations, it will take into account political and sociological factors which might make control difficult. We attach great weight to unifying at the planning stage the requirements of development and control. We also attach great weight to the inseparability of the two functions in the personnel of the development authority.

As we have pointed out before, the Authority will be aided in the detection of illegal operations by the fact that it is not the motive but the operation which is illegal. Any national or private effort to mine uranium will be illegal; any stockpiling of thorium will be illegal; the building of any primary reactor or separation plant will be illegal. This circumstance is of very great importance for the following reason: It is true that a thoroughgoing inspection of all phases of the industry of a nation will be an unbearable burden; it is true that a calculated attempt at evasion may, by camouflage or by geographical location, make the detection of an illegal

operation very difficult. But the total effort needed to carry through, from the mine to the bomb, a surreptitious program of atomic armament is so vast, and the number of separate difficult undertakings so great, and the special character of many of these undertakings so hard to conceal, that the fact of this effort should be impossible to hide. The fact that it is the existence of the effort rather than a specific purpose which constitutes an evasion and an unmistakable danger signal is one of the great advantages of our proposals.

We have frequently emphasized the difficulties of providing an inspection agency personnel with the qualifications necessary for that work. Free association of the Authority's scientists with those engaged in private or national undertakings will greatly reduce the chance of evasive national or private action, or of the existence, unknown to the Authority, of technical developments which might constitute a potential danger.

It is our hope that when the Authority is in full operation it will have obtained a sufficiently complete control over raw materials and the fissionable products so that no elaborate and formal inspection procedures will be needed to supplement it. The more rapidly the initial steps leading to the Authority's control of raw materials are taken, the greater the chance of the elimination of the more burdensome forms of inspection. The geological survey, while in a sense inspection, will be focussed on a world-wide search for the essential raw materials.

Through the location of the Authority's laboratories in various parts of the world, it should become cognizant of a wide range of research and development activities in various countries. In operating mines, refineries, and primary production plants in various countries, the personnel of the Authority will likewise acquire insight regarding the activities and trends in various countries.

In licensing power reactors the Authority would send its representatives to inspect or visit these plants at frequent intervals. Under the relations described between the Authority and national or private groups using denatured fissionable material, the inspectors would have a right of access deriving from the terms of the license and lease. Furthermore, the Authority will have a unique knowledge of the whole field of atomic energy. To the extent inspection was required it could be done by engineers or scientists who would be far more knowledgeable than those inspected and who could furnish useful advice at the same time.

In the course of its activities, the Authority might acquire information which would cause it to suspect evasions or violations in places to which it did not have the right of access. Some means would have to be provided so that the Authority, by making out a prima facie case, would be granted access to the suspected plant or laboratory. This might be arranged through the presentation of such a request to some international body such as the International Court. The procedure seems sufficiently limited in its effect upon national sovereignty to be practical.

ORGANIZATION AND POLICIES OF ATOMIC DEVELOPMENT AUTHORITY

Until qualified men set themselves the task of actually writing a charter, chapter by chapter, anything said about policies must be merely by way of preface. The actual statement of policy, like the form of organization, will have to grow out of the international discussions and deliberations.

The charter should, so far as practicable, define the areas in which there must be an exclusive international operation, and the areas in which there may be national and private operations. A difficult problem will be to provide the means to redefine as either "dangerous" or "safe" when new knowledge shifts the line.

It will probably be necessary to write into the charter plan governing the location of the operations and property o the Authority so that a strategic balance may be maintaine among nations. In this way, protection will be afforded agains such eventualities as the complete or partial collapse of th United Nations or the Atomic Development Authority, sudde seizure by any one nation of the stockpiles, reduction, refinin and separation plants, and reactors of all types belonging t the Authority.

At present, with Hanford, Oak Ridge, and Los Alamos situate in the United States, other nations can find no security agains atomic warfare except the security that resides in our ow peaceful purposes or the attempt at security that is seen developing secret atomic enterprises of their own. Other na tions can develop a greater sense of security only as th Atomic Development Authority locates similar dangerous oper tions within their borders. It is not thought that the Atom Development Authority could protect its plants by milita force from the nation in which they are situated. Some Unit Nations military guard may be desirable, but it could be litt more than a token. The real protection will lie in the fact th if any nation seizes the plants or the stockpiles that a situated in its territory, other nations will have similar faci ties and materials situated within their own borders so th the act of seizure need not place them at a disadvantage.

With appropriate world-wide distribution of stockpiles a facilities; with design rendered as little dangerous as pos ble; with stockpiles of dangerous materials denatured a kept at the lowest level consistent with good economics a engineering, there will be no need for a sense of insecuri on the part of any of the major powers. Seizures will affo no immediate tactical advantage. They would serve as a dang signal, and under the conditions stated, a substantial peri of time will be left for other nations to take all measures defense. For a year or more would be required after seiz before atomic weapons could be produced in significant quan ties. Psychologically, the fixing of danger signals that are cle simple, and vivid seems to us of utmost importance.

The needs of nations for new power resources vary only with industrial conditions, but also with their proxim to water power, coal and petroleum. Power will be produ in the very process of operating the dangerous producti plants which make fissionable materials. The distribution these plants throughout the world will have to be based prima ly on security considerations. But there will still be ample ro for an individual nation to determine where the internatio plant shall be situated in relation to its own economic and cial needs.

In the case of non-dangerous plants, using denatured ma rials, the charter should provide for allocation in accorda with more conventional economic standards.

Section IV

THE TRANSITION TO INTERNATIONAL CONTR

In the pronouncements which the United States has ma the commitment for action has been coupled with the requi ment that moving toward the goal of international collabo tion must be accompanied at each stage by appropriate sa guards.

The period of transition may be broken down into two s periods. In the first there will be discussions in the Ato Energy Commission of the United Nations Organization, posals will be referred to the UNO and to the several nati From this process there will result a charter ratified by various nations. In the second period, after the Atomic Deve ment Authority is created, it would, of course, be possible leave the sequence of activities to its own discretion. Bu seems more likely that provisions governing this sequence be provided in the charter.

E POSITION OF THE U. S. DURING THE TRANSITION

Today the United States has a monopoly of atomic weap- We have strategic stockpiles; the facilities for making the redients of atomic bombs and the bombs themselves; a e group of people skilled in the many arts which have e into this project; experience and know-how obtainable in the actual practice; considerable resources of raw erials; and we have a broad theoretical knowledge which appear inadequate in the future, but which enables us valuate not only the performance of the past but also what future is likely to hold.

nherent in any plan of international control is a probable leration of the rate at which our present monopoly will ppear, since our knowledge and our mastery of practical , and to some extent our physical installations must ulti- ely be made available to an international agency. When the is in full operation, no nation will be the legal owner tomic weapons, of stockpiles of fissionable material or raw erials, or of the plants in which they can be produced.

Ve must ask ourselves this question: What will be the e of affairs should the plan be adopted with the intention vasion or should evasion be undertaken by any nation dur- the years when it is being put into effect?

The basis of our present monopoly lies in two things: knowl- , and physical facilities. The balance toward which a plan international control must work will mean the loss of both s of monopoly. But quite different considerations are in- ed in the sharing of our knowledge and in the balancing of ical facilities.

MATERIAL ASPECTS OF THE TRANSITION

n the discussions within the United Nations Commission, even more in the early planning phases of the Authority's , there will have to be some disclosure by us of theoretical rmation. But these will not essentially alter the present riority of the United States. They will not move its stock- of uranium or of fissionable material or its bombs or perating plants, and need not alter the operation of these ts. They will not create in any other nation the know-how h is so great a part of our present superiority.

No matter what may be the schedule of operations adopted, present preferred situation cannot change overnight. Never- ss, very serious consideration must be given to the schedul- of changes which over a period of years will bring about lanced international operation. The charter may provide some things should not be done before a specified number ears, or before the activities of the Authority, let us say, e field of raw materials, have reached a certain stage of tiveness.

he first major activities of the Authority must be directed btaining cognizance and control over the raw materials. raw materials control will bring the Authority face to with the problem of access, which is both a technical and litical problem.

here are other things which no doubt the Authority would to do at once. Without much delay it should set up laborato- for the study of nuclear physics and the technological lems that it must expect to encounter in its future work.

n considering the special position of the United States, there he following important components, the transfer of which e jurisdiction of the Authority will have to be very care- scheduled: our raw material supplies; the plants at Oak e and Hanford; the stockpiles of bombs now in our posses- the stockpiles of undenatured fissionable materials; our ic bomb plant and laboratory at Los Alamos.

he significant fact is that at all times during the transi- period such facilities will continue to be located within United States. Thus, should there be a breakdown in the at any time during the transition, we shall be in a favor- position with regard to atomic weapons.

DISCLOSURE OF INFORMATION AS AN ESSENTIAL OF INTERNATIONAL ACTION

One of the elements in the present monopoly of the United States is knowledge all the way from theoretical matters to practical details of know-how. It is not possible to give a reliable estimate of how must its revelation would shorten the time needed for a successful rival effort. It is conceivable that it would not be significantly shortened, or that it might be shortened by a year or so. It is, of course, clear that even with all theoretical knowledge available, a major program, surely lasting many years, is required for the actual production of atomic weapons.

Our monopoly on knowledge cannot be, and should not be, lost at once. There is a rather wide freedom of choice in the actual scheduling of disclosures. Here considerations of acceptability and of general political background will make a decisive contribution.

It is true, as the Secretary of State has said, that there is nothing in the Resolution setting up the Atomic Energy Commission, that compels the United States to produce information for the use of the United Nations Commission. But unless we are prepared to provide the information essential to an understanding of the problem, the Commission cannot even begin the task that has been assigned to it. Much of the information which is required for this purpose is already widely known. There are further necessary items now held by us as secret. They are largely qualitative; and they involve almost nothing of know-how.

When the Atomic Development Authority is in existence and undertakes operations in a given field, it must have all information bearing on that field—practical as well as theoretical. Thus, if the Authority attempts to obtain control of raw materials, we must make available to it all knowledge bearing on this problem. This will, of course, be a common obligation on all participating nations. Conversely, should it be determined that research and development in the field of atomic explosives will be undertaken by the Authority only at a late date, the information relating to such developments would not be required by it in the earlier phases. Before the Authority can undertake the construction of reactors or the development of power, it will have to spend some time in planning these activities, and pertinent information must be made available early enough to make such planning effective.

We may further clarify the nature of the disclosures required by a reference to a report of December, 1945, prepared for the Manhattan District by its Committee on Declassification. This Committee was directed to report on a policy which would best protect national security. It divided our secret information into three categories, the first of which it recommended for immediate, and the second for eventual declassification in the interests of long-term national security; while the third should not be classified in the absence of effective international control. Of our still secret data essential as a basis for discussion in the UNO Commission, many are included in Class One; the remainder are all in Class Two, and comprise perhaps one-third of the items there listed.

When fully in operation the plan herein proposed can provide a great measure of security against surprise attack. It can do much more than that. It can create deterrents to the initiation of schemes of aggression, and it can establish patterns of co-operation among nations, which may contribute to the solution of the problem of war itself. When the plan is in full operation there will no longer be secrets about atomic energy. We believe that this is the firmest basis of security; for in the long term there can be no international control and no international co-operation which does not presuppose an international community of knowledge.

The State Dep't Report - 'A Ray of Hope' . . *Edward Telle*

International control of atomic energy is a peculiarly difficult problem. If the control fails the world will be exposed to destruction which no one can now imagine or delineate. Due to secrecy, few people have sufficient information to discuss the problem intelligently and even these few cannot predict how the technics of the atomic age will develop and what controls will be necessary a few years hence.

The report prepared by the board of consultants to the State Department is the first ray of hope that the problem of international control can, actually, be solved. The report proposes a bold and dangerous solution; but inaction and an unplanned drift into international competition would be still more dangerous. Instead of searching cautiously for a minimum of action, the board proposes an aggressive policy of planned progress and international cooperation.

The recommendation of the board is the following: An international "Atomic Developmen Authority" (ADA) shall be set up with a dual purpose: to aid in developing peaceful applications of atomic powers and to devise and administer a procedure aimed at prohibiting military use of atomic energy. The ADA will prospect, mine and refine uranium and thorium; it will enrich U235; it will produce plutonium in power plants to be equitably distributed throughout he world; and it will carry out research and development in atomic explosives. No nation or individual will be permitted to engage in any of the above activities. In other fields connected with nuclear physics, independent work by nations, research institutions and individuals should be encouraged. For this purpose, the ADA will make available radioactive materials for scientific, medical and technological work. It will lend uranium 235 and plutonium for use in small nuclear reactors which will serve as sources of neutrons and gamma-rays and will be most valuable research tools. These reactors will be run at a low power-level and therefore wlil be unsuited to the production of bomb materials in dangerous amounts. Uranium 235 and plutonium will be also loaned, under certain safeguards, for use in units producing power in significant amounts. These larger units are dangerous because they are in principle suited to produce atomic explosives in significant quantities.

The following safeguards against misuse and evasion are contemplated:

(1) It will be difficult to prospect or to mine uranium and thorium secretly if the ADA engages in this work on a worldwide scale. Without these raw materials atomic explosives cannot be produced in large amounts, not even with the help of an atomic power plant.

(2) Designs for nuclear reactors and power plants operated by national governments or individuals must be approved by the ADA. The approved designs will be such as to make it impossible or at least difficult to use these plants for production of additional nuclear explosives.

(3) Uranium 235 and plutonium will be loaned in a denatured form, in which they are "unusable by any methods we now know for effective atomic explosives." One can develop methods for removing the denaturant, but this requires "scientific and engineering skill of an appreciable order."

(4) All reactors and power plants will be inspected from time to time. The inspection may take the form of cooperation in engineering and research between the ADA and the men who operate the reactors and power plants.

(5) Through the varied scientific activities of the ADA contacts will be established with most interested scientists and engineers in each country. This in itself will make secret activities in the relevant fields quite difficult.

Excepting the control of raw materials no systematic or large scale inspection is contemplated. The authors of the report are of the opinion that an extended or rigid inspection is unworkable, for it is a police measure which would engender a desire for evasion. It would not attract the high-class inspection personnel without whose ingenuity the inspection could not work. The proposed scheme on the other hand is a positive program in which the best qualified talent of each country would gladly participate.

The report also contains a discussion of the transition period during which the plan is to be put into effect. At present, the United States enjoys an advantage over other nations. This advantage consists of knowledge, experience, stock piles and plants. The ADA will evolve a system in which no one nation has such advantages.

It is proposed that this should happen gradually as the ADA develops. For any advantage that we give up we shall be compensated by the progress of international organization and security. Detailed know-how, stock piles and plants need not be shared in the initial phases of planning. Theoretical knowledge must be made available at an earlier date because without some general knowledge the organization cannot be set up in an intelligent way. If the international organization should break down the disclosed information may shorten the time a competitor would need to develop atomic bombs. It is claimed in the report that the time may be shortene by not more than a year or so.

The technical facts or assumptions o which the report is based are:

(a) Theoretical and scientific found tions of atomic power are well enough u derstood so that we know in what dire tion to look for further development Thus an organization which itself is ve active in research and development ca keep abreast with discoveries and mai tain intelligent leadership and control.

(b) All exploitation of atomic pow must start from the raw material, uran um. To some extent uranium can be r placed by thorium. Rich uranium a thorium minerals are not widesprea Complete control of uranium and thoriu production seems, therefore, feasible.

(c) Nuclear reactors and power plan can be so constructed as to make it dif cult to use them for the production atomic explosives. If explosives are p duced, this can be detected rather easi by an experienced person having un stricted access to the power unit.

(d) Uranium 235 and plutonium can so denatured that they keep their usef ness in power producing units but can be used in atomic bombs. Removal of t denaturant is difficult.

(e) Disclosure of purely theoretical formation will speed up a potential co petitor by not more than one year.

Of these statements all but the last t are well founded, although none is ab lutely certain. For instance the prosp that the ADA will be able to keep up w the development of the art is a probabil and not a certainty. But no progress co be made in the difficult question of int national control if only foolproof ar ments were admitted.

The assumptions under (d) and (e) serve special comment.

The report's statements about denatu materials seem over-optimistic. Denat ing is certainly to be recommended, as of the several safeguards which will m violation of international control more ficult. But denaturing does not make use of materials in atomic bombs absolu ly impossible; it only impedes this use.

The assumption that disclosure of th retical information will speed up a com titor by not more than a year is plausi But it depends on so many intangible f tors that one wonders how the board v tured to make so definite a statement. theoretical investigations have helped to avoid many pitfalls. Can we be s that our competitors will not make m takes and lose much time, unless they warned by us? Are we sure that they not have now information which, if ad

(Continued on page 13)

raft for a Convention on Atomic Energy . . *Quincy Wright*

orking together with members of the nic Scientists of Chicago and the Office Inquiry into the Social Aspects of nic Energy of the University, Quincy ght, Professor of International Law author of "A Study of War," has pre-d a preliminary version of a Draft vention for international control of nic energy.

HEREAS, the use of atomic weapons purposes of offense or defense might t in such destruction as to threaten existence of civilization;

HEREAS, the General Assembly of United Nations has suggested,

That the exchange of basic scientific information for peaceful ends should be extended between all nations;

That atomic energy should be controlled to the extent necessary to insure its use only for peaceful purposes;

That atomic weapons and all other major weapons adapted to mass destruction should be eliminated from national armaments; and

That complying states should be protected against the hazards of violation and evasion by effective safeguards by way of inspection and other means;

ORDER to eliminate atomic weapons national armaments without prejuto subsequent elimination of other ons adapted to mass destruction, to the use and development of atomic gy for civilian purposes under United ons control, and to assure the carryut of these purposes;

e Parties to this Convention agree, as ws:

EFINITIONS

For the purpose of this Convention:

a. Fissionable materials include U235, ium enriched in U235, and plutonium.

b. Source materials include uranium thorium metals, compounds and ores.

c. An atomic weapon is any appliance ble of utilizing, for the destruction of or property, the explosive effects of elease of nuclear energy or the poiss effects of fissionable materials or roducts obtained from the relase of ar energy.

d. A nuclear power installation is any llation capable of producing nuclear y at a rate of over 10,000 kilowatts.

PROHIBITIONS

The Prohibitions in this section shall egarded as rules necessary for the tenance of international peace and ity enforceable by the United Nations spect to all states as provided in ar-1, par. 6, of the United Nations Char-

The use of atomic weapons for any purpose whatever is forbidden subject to the provisions of article 42 of this Convention.

4. The possession, manufacture, import, or export of atomic weapons, or parts of such weapons, or of facilities or materials intended for the manufacture of such weapons is forbidden.

5. The establishment or operation of any nuclear power installation or other facility, containing or capable of producing fissionable materials in substantial quantities or the establishment or operation of any other facility capable of producing fissionable material in substantial quantities is forbidden for a period of five years, except under the authority of the Bureau of Nuclear Studies, as provided in Article 26 of this Convention.

6. The mining, manufacture, import, or use of fissionable materials or sources of fissionable materials is forbidden except as licensed by the Administrative Commission, as provided in Article 27 of this Convention.

7. The operation of any installation for the production of fissionable materials even after the expiration of the five year period referred to in article 5, is forbidden, except by the Administrative Commission, which shall have title to fissionable materials produced therein.

8. All atomic weapons in existence when this Convention comes into force shall be destroyed or disassembled under supervision of the Administrative Commission. All stocks of fissionable materials in existence when this Convention comes into force shall be transferred to the Administrative Commission for safe-keeping in appropriate parts of the world until their use is authorized by an establishment licensed by that Commission.

9. All installations or facilities forbidden by article 5 of this Convention and in existence when the Convention comes into force, shall be placed in stand-by condition under control of the Administrative Commission until such time as they may be operated or their use may be licensed by that Commission in accordance with this Convention.

10. Every state shall take appropriate measures to enforce these prohibitions within its jurisdiction and shall acquiesce in whatever measures may be taken by the United Nations or its agencies as provided in this Convention. It shall send copies of all laws and regulations on the subject to the Inspection Commission.

III. ATOMIC ENERGY COMMISSION

11. An Atomic Energy Commission shall be established at the seat of the United Nations. It shall consist of representatives of the members of the Security Council and Canada when Canada is not represented on that Council, and shall be regarded as continuous with the Commission recommended by the resolution of the United Nations General Assembly on January 24, 1946.

12. The Atomic Energy Commission may make recommendations to the Security Council or to the General Assembly by a majority vote of its entire membership and shall meet at least once a year.

13. The Atomic Energy Commission shall be competent to recommend regulations supplementary to this Convention and modifications of this Convention as in its opinion new discoveries or inventions in the field of atomic energy make such changes necessary or expedient. In particular, it shall recommend before the five year period referred to in article 5 has expired, whether nuclear power installations should be permitted and if so, whether they should be operated or merely licensed by the United Nations Administrative Commission; whether large scale production installations should be operated by the Administrative Commission; and the criteria by which a particular installation should be permitted.

14. The Security Council shall consider recommendations of the Atomic Energy Commission and regulations so recommended, if supplementary to this Convention, shall come into force when approved by a vote of seven members including all of the permanent members of the Security Council. If the recommendation involves amendment of this Convention, it may be submitted directly to the General Assembly, or the Security Council may by a vote of any seven members submit it to the General Assembly for consideration according to the procedure set forth in art. 43 of this Convention.

IV. INSPECTION COMMISSION

15. An Inspection Commission shall be established at the seat of the United Nations. It shall be composed of fifteen members, no two of whom may be nationals of the same state.

16. The members shall be selected by concurrent vote of the General Assembly and the Security Council of the United Nations from persons with expert qualifications in the field of atomic energy, nominated by the states parties to this Convention. A simple majority in each body voting independently shall be necessary to elect.

17. Each state party to this Convention shall be entitled to nominate three months before an election four persons, not more than two of whom shall be of its own nationality.

18. The members of the Inspection Commission shall be elected for nine years

Draft for a Convention on Atomic Energy . . . *Continue*

and may be re-elected, but the members chosen at the first election shall be divided by lot into three classes to serve respectively for nine, six and three years.

19. No member of the Inspection Commission may exercise any political or administrative function under any government and shall receive compensation from the United Nations, to be determined by the Security Council.

20. The Inspection Commission shall have authority to appoint permanent inspectors at all mines, installations and facilities producing an important quantity of fissionable material or sources of fissionable material, and to authorize inspectors to visit periodically laboratories and experimental work using an important quantity of fissionable material, whether operated by the United Nations, by national governments, by local governments, or by private individuals. Inspectors should be appointed with the nationality of countries distant from that inspected.

21. The Inspection Commission shall have authority to authorize aerial or other surveys to assure knowledge of new mines for the production of sources of fissionable material in any area where it has reason to think such mines may have been opened.

22. The parties to this Convention shall permit access by inspectors authorized by the Commission to all mines, factories and laboratories which in the opinion of the Commission may be engaging in atomic energy activities and to the air space in case an aerial survey is authorized.

23. The Inspection Commission shall report quarterly to the Security Council and shall make its reports public unless the Security Council, within a month after the submission of the report, declares publication inexpedient. The Inspection Commission shall act by majority vote and the Security Council shall in this matter act by a vote of any seven of its members.

V. ADMINISTRATIVE COMMISSION

24. An Administrative Commission shall be established at the seat of the United Nations. It shall be composed of nine members no two of whom shall be Nationals of the same state and the members shall be selected, qualified and compensated as provided in articles 16, 17, 18, and 19 of this Convention.

25. The Administrative Commission shall have authority to own or operate mines producing uranium or thorium, installations for the production of source materials, installations for the production of fissionable materials and nuclear power installations within the territory of member states, insofar as the establishment of such installations may be permitted after five years. The parties to this convention agree that mines which constitute major sources of uranium or thorium, and installations for refining these products, shall be owned or operated by the Administrative Commission.

26. The Administrative Commission shall establish a Bureau of Nuclear Studies and shall appoint the members thereof from qualified persons from the states parties to this Convention. It may authorize the Bureau to operate a limited number of experimental nuclear power installations and to conduct other investigations in order to determine standards of design, operation and inspection for such installations and to facilitate the activities of the Inspection Commission. It may authorize the Bureau to produce and distribute a limited amount of fissionable material for activities licensed as provided in article 27 of this Convention. The Administrative Commission shall have title to all such installations and shall retain title to all fissionable materials which may be produced and distributed. It may authorize the publication of reports of the Bureau of Nuclear Studies and on the advice of that Bureau it may promulgate official standards, constants and definitions of nuclear science.

27. The Administrative Commission shall have authority, subject to provisions of Article 25 to license the operation of mines producing uranium or thorium, the conduct of experimental or medical activities using fissionable material supplied by the Commission, and the export or import of fissionable materials or sources of such materials.

28. The Administrative Commission shall prepare detailed regulations specifying the conditions under which licenses shall be issued, including the qualifications of licensees and the size, quantity, distribution and characteristics of permitted operations. These regulations shall come into force when approved by the Security Council by a vote of seven members including all the permanent members.

29. The regulations should require the automatic issuance of licenses for experimental work to laboratories which meet specified qualifications.

30. The regulations may leave the Commission a measure of discretion in the issuance of licenses for the operation of mines, nuclear power installations if and when permitted, and export or import of fissionable materials or sources of such materials, giving consideration to the world requirements for sources of atom power and for fissionable materials f peaceful purposes, and to the requiremen of states which lack sources of fissio able materials within their territories.

VI. SCIENTIFIC INFORMATION

31. Publication of basic scientific info mation including experiments and disco eries shall be regarded as a fundament freedom of individuals protected by t United Nations. No state shall preve such scientific publication, especially in t field of atomic research.

32. In order that atomic science m advance, research workers in this fie shall be encouraged by the parties to th maintaining a code of ethics requiri prompt publication of scientific results.

33. The United Nations Education Scientific and Cultural Organization m take appropriate measures to assist in t formation of such associations.

VII. INDIVIDUAL OFFENSES

34. Each state shall provide in its cri inal code for the punishment of individ als who commit any of the following a Convention to form international assoc tions for exchanging information and f and may exercise jurisdiction over su offenses wherever committed, provided t defendant is within its custody:

a. The possession, manufacture, i port, or export of atomic weapons, parts of such weapons, or of materials tended for the manufacture of such wea ons.

b. The establishment or operation any nuclear power installation or ot facility containing or capable of produc fissionable materials in substantial qu tities or the establishment or operat of any other facility capable of produc fissionable material in substantial quan ties, except for experimental purposes der authority of the Bureau of Nucl Studies.

c. The mining, manufacture, imp export, or use of fissionable materials sources of fissionable materials without cense from the Administrative Comm sion.

d. Interference with the conduct inspections under authority of the Uni Nations Inspection Commission and c veying of false information to inspect or concealing atomic energy activi from inspection.

e. Interference with the publicat of scientific information concerning ato energy and fissionable materials.

f. Intentional participation in above mentioned acts, conspiracy to c

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aft for a Convention on Atomic Energy

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any of these acts, and attempting or aring to commit such acts.

Any of the United Nations perma- y represented in the Security Council indict any individual before the ed Nations Criminal Court for viola- of any of the acts mentioned in arti- 4 of this Convention and that Court determine the penalty in accord with aw of the place where the act was nitted, the law of the state of which individual is a national, or the law e indicting state whichever it deems suitable.

An individual so indicted shall be ndered to the custody of the United ons Criminal Court by the state of m when requested by that Court.

The organization and procedure of Jnited Nations Criminal Court shall hat provided for the International inal Court under the convention of va of November 16, 1937.

ENFORCEMENT

The Security Council shall prompt- nsider any report of the Inspection nission indicating violations or eva- of this Convention and shall make nmendations thereon considering the er a situation threatening the peace r article 34 of the United Nations ter.

If any member of the United Na- charges a violation of this Conven- recommendations may be made by ecurity Council under articles 35 and the Charter on such a dispute with- counting the votes of the disputing , as provided in article 27 of the d Nations Charter.

The Security Council shall at once the measures contemplated in articles of the United Nations Charter in its recommendations are not prompt- mplied with.

If the Security Council is unable ecide upon appropriate measures for cing this Convention, the members e United Nations may exercise the ent right of individual or collective efense in accordance with article 51 e Charter, until the Security Council aken the measures necessary to main- international peace and security. The re of a member to comply with a rec- endation of the Security Council may garded by any party to this Conven- as an armed attack in the sense of e 51 of the United Nations Charter.

The necessity for forcible action aintain this Convention, whether in ance of a decision of the Security cil or in pursuance of the right of idual and collective self-defense, shall not abrogate this Convention or confer upon any state a right to manufacture atomic weapons unless in pursuance of an explicit authorization by the Security Council or in reprisal because of manufacture of atomic weapons in violation of this Convention; nor does it confer upon any state a right to use such weapons unless in pursuance of an explicit authorization by the Security Council or, if the Security Council fails to take appropriate measures, in reprisal because of use, or immediate danger of use, by another state in violation of this Convention.

IX. AMENDMENTS

43. Amendments to the present Convention shall come into force for all states parties to the Convention when they have been adopted by a vote of two-thirds of the members of the General Assembly of the United Nations and ratified in accordance with their respective constitutional processes by two-thirds of the states parties to the Convention, including all of the permanent members of the Security Council.

44. Amendments may be proposed to the General Assembly by the Atomic Energy Commission, by the Security Council or by any party to the Convention.

X. SIGNATURE AND RATIFICATION

45. The present Convention shall remain open for signature on behalf of any member of the United Nations and on behalf of any non-member state to which a copy thereof is communicated for that purpose by the Security Council of the United Nations.

46. The present Convention shall be ratified by the signatory states in accordance with their respective constitutional processes. The ratification shall be deposited with the Secretary General of the United Nations who shall notify all the signatory states of each deposit.

47. The present Convention shall come into force among the ratifying powers upon the deposit of ratifications by the states permanent members of the Security Council and by Canada, Belgium and Czechoslovakia. A protocol of ratifications deposited shall thereupon be drawn up by the Secretary General of the United Nations who shall communicate copies thereof to all the signatory states.

48. For any state signatory to the present Convention which ratifies it after it has come into force the Convention shall come into force on the date of the deposit of its instrument of ratification.

H. C. Urey on State Dept. Report

The State Department report on control of atomic energy under the United Nations is in my opinion the most statesmanlike pronouncement that has been made on the subject since the atomic bomb fell on Hiroshima. Its particular virtue lies in the fact that it proposes an authority which has positive objectives, rather than the purely negative ones of control by police action only. After the months of narrow discussion of keeping the secret, it is like awakening from a bad nightmare. This report deserves the careful consideration and support of all thinking citizens of the United States. It probably emphasizes the importance of denatured material more than it should, for after all, the thing which must occupy our attention is the control of dangerous materials. These will still be produced under the control of the United Nations, and will exist in all important countries of the world.

Our essential problem is the safe control of these materials. The difficulty in the situation, which I believe will be surmounted, lies in the United Nations Organization itself, and not in the report, since the United Nations can enforce no regulations except by war, and because the peoples of the world have not yet given it their loyalty. This cannot be changed quickly, and it may be, in fact, that the Atomic Development Authority, if it can be established, will itself aid in strengthening the United Nations Organization and in giving it the powers which it must ultimately have if we are to avoid the use of atomic bombs and if we are to move from that control to one that prevents war.

TELLER . . . **Cont. from p. 10**

to the knowledge which we can transmit to them, will produce practical results much faster than we may imagine now?

This criticism is, however, directed only against minor points in the report. The main facts presented are certainly correct and the suggestions made are ingenious, daring and basically sound. It is the right decision to make materials available for important research and development projects, even if these materials are dangerous. By taking this risk, one will have gained more than one has lost. If such a liberal policy is pursued, people will be less desirous to break or circumvent international agreements.

If the constructive and imaginative spirit of the State Department report is compared with the "Maginot-line" mentality of "keeping the secret", one can hardly doubt in which direction our eventual hope for safety lies.

Atomic Energy and The UNO Atomic Energy Commissio

. . . . *P. M. S. Blacke*

The Washington pronouncement, signed by the President of the United States, the Prime Ministers of Great Britain and Canada, paved the way for the Moscow agreement at the end of December. This was signed by the Foreign Secretaries of the U.S.S.R., U.S.A. and U.K. and stated that the three Governments would sponsor a resolution, at the first meeting of the Assembly of the United Nations Organization, to set up an Atomic Energy Commission.

Finally we have the resolution of the Assembly itself setting up the Commission.

The terms of reference of the Commission are bold and wise, and we must all, I think, feel gratitude to the statesmen of the United Nations who wrote them.

But to draw up wise and bold terms of reference is not sufficient. Action must follow. I am convinced that the utmost public initiative and vigilance is necessary in all countries to make quite sure that the Commission's work bears fruit, quickly and efficiently.

Perhaps the most significant point about the terms of reference of the Commission is that they link the problems of the control of atomic energy with the elimination of other weapons of mass destruction. The recent official statement about biological warfare gives point to this broader objective. For, for all we know, biological warfare might prove even more destructive than atomic bombs! Looked at even more broadly, we note that some twenty million people were killed in the last six years without the use of atomic bombs or of biological warfare!

The setting up of the Atomic Energy Commission is a major achievement. To consider the next step, one needs a detailed discussion of how U.N.O. can function.

THE SECURITY COUNCIL

It is abundantly clear that the problem of the control of atomic energy cannot be separated from the problem of the avoidance of future major wars. The method envisaged in the Charter of the United Nations for the settling of disputes that might lead to war, and for the application of sanctions against nations which disturb the peace, must be discussed in some detail.

Article 42 of the Charter authorizes the Security Council "to take such action by air, sea or land forces as may be necessary to maintain or restore international peace and security".

Article 43 instructs all members of the United Nations to make available to the Security Council the armed forces necessary for the purpose of maintaining international peace and security.

Thus the Charter lays down the method of imposing sanctions. But it also lays down the rules under which the voting for sanctions must take place. Paragraph 3 of Article 27 lays down that decision must "be made by an affirmative vote of seven members, including the concurring votes of the permanent members".

This rule, which demands the unanimity of the Five Great Powers, is not only, in my view, an essential feature of the Charter; it is also of primary importance in any consideration of the problem of international control of Atomic Energy.

There is a rather vociferous school of thought which considers that this so called "veto" is a "blot on the Charter", and that every effort should be made to revise the Charter so as to get rid of it. This view, in my opinion, is quite incorrect. It fails to take into account the real problem and limitations in the applications of sanctions.

SANCTIONS

Sanctions must either lead (a) to the restraint of the offending nation without war, or (b) to a short "police" type of war.

If, however, the contending groups of powers are of comparable military strength, then the attempt of one group to impose its will on the other group will lead to the outbreak of a major war. In this case, each side will tend to say that it is imposing sanctions on the other, meaning that it believes its cause is just and its action "legal." Since the word "sanctions" in the latter sense is merely another name for engaging in and "legalising" a major war, the word in this sense has no legitimate place in the terminology of U.N.O.

Now it is immediately obvious that there might exist a state of the world where no sanctions at all are applicable. For instance let us imagine that there are only two powers of comparable strength in the world. Then clearly neither power can apply "sanctions" to the other. If on the other hand, there are supposed to exist a fairly large number of states, then sanctions are applicable to one offending nation if the military strength of the remaining states is overwhelming relative to that of the offending nation. We mean by overwhelming strength simply that which is required to induce capitulation or quick victory.

It is clear that the voting rules on the Security Council must only allow the voting of sanctions, in those cases where there is the requisite force to carry them out. To set up a system which allow the voting of sanctions which could not carried out would rapidly lead to the di ruption of U.N.O. Voting would becor a method of displaying a moral attitu rather than a procedure for ensuring a tion.

Since it is roughly true to say that t distribution of power among the natio is such that sanctions could not be appli at present against at any rate some of t great powers, it is essentially correct th these particular great powers should ha the right of vetoing the application sanctions against themselves.

However ardently we may wish for state of the world where there are dangers of wars and social struggles, is committing an unforgivable mistake we fail to base our action on a proper a preciation of what are the actual facts the present situation.

The sovereignty of the individual po ers is a fact. The co-operation of great powers will ensure peace. No lega ties, procedure, charters, Commissions, Councils will achieve it if the major po ers contemplate fighting each other.

THE EFFECTS OF THE ATOMIC BOMB ON THE CHARTER

In the first months after the use of Atomic Bomb, the opinion was quite wi ly held in some quarters that the Char was now out of date, and in particular t the "unanimity rule" must be modifi This view is less heard today, now t the true potentialities and limitations atomic bombs are becoming more clea recognized.

I do not think I need to stress the t rific destruction which would result fr another major war between the Gr Powers in which Atomic Bombs were us In particular, the United Kingdom, w its concentrated population, largely great cities near the coast, and with v limited power of dispersal, becomes most or quite undefendable.

If we were at war with a nation hold the Channel coast as in 1944, Engl would be exposed to bombardment rockets with atomic war heads. Lon and the Southern English towns wo clearly be wiped out, and no conceiva air defence could prevent the rest of cities from being successfully attacked aircraft.

Clearly the rough effect of atomic bo on the world power position in, say, fiv ten years time, is to strengthen still ther the Great Powers against the sr

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in particular to strengthen the powers extensive territories.

e must continually keep in our minds real position about armed sanctions. can only be applied if the Great ers are in agreement; hence they canbe applied against a great power. But l cases where the great powers are in ement there would always be availan overwhelming superiority for the osition of sanctions by **normal** weapons nst some other power or powers. ce atomic weapons would not be needo make the imposition of sanctions ible.

, on the other hand, the great powers le to fight among themselves, then ainly atomic weapons may have an rtant if not decisive effect. However, a war means the dissolution of .O. Then, it remains true that Atomic pons can play no part in the armory he United Nations.

ery similar arguments apply to other pons of mass destruction. They are in general, needed for the application anctions by the United Nations Organon. Their very character as weapons mass destruction makes their use in to stop aggression improbable. A consideration of the type of military ation now taking place, say, in Pales- or Java, will show that atomic bombs, gical warfare and large scale bombing ivilian populations have no part to

SIBLE POLICIES

et us consider the possible policies:— rstly, there is the Policy of having no cy. This means, either proposing no tive steps, or of advocating some ian scheme, such as the immediate ng up of a World Government or Parent of man, of such a character as to ertain to fail to materialize, leaving ing in fact done.

he disastrous consequence of this se, involving a race between the Great ers to produce atomic bombs, biological pons, long range bombing forces, deed to attack the civilian population, range rockets, etc., are too obvious to emphasis here. Further, a mad mble for control of the world's sup- of Uranium would be inevitable.

wo points, equally obvious, are worthy epetition. Of all the Great Powers, t Britain can least afford to see such ce developing. I think it an exaggera- to say that another major war with ic and biological weapons would end ization. But it certainly would end a t many things, and the first and the t doomed of victims would be many ures of British life as we know it y.

he second point is that the choice is just whether, say, Britain or any other country adds or does not add to her other weapons, some bombs or bacteria prepared in secret laboratories or factories. It is military adventurism of the most dangerous kind to base one's defense policy on the use of primarily offensive weapons such as atomic bombs, without at the same time taking all possible defensive measures against the same weapon. Now, in the case of the atomic bomb, these measures involve at the least a major revolution in the normal life of the country and a drastic fall in the standard of life, owing to the colossal expense of the necessary defensive measures. It might be argued that we should make atomic bombs and learn to live half underground; but it would be most dangerous for a vulnerable country like ours to make atomic bombs and to take **no** drastic passive defense measures.

Some people have suggested the handing over of Atomic Bombs to U.N.O. A little reflection shows the unreality of the suggestion. U.N.O. is not an organism existing apart from its constituent nations, nor standing over and above the Great Powers. If the Great Powers fell out with each other, the existence of a stock of bombs nominally held by U.N.O. would have little effect on the situation.

COMPLETE ELIMINATION OF ATOMIC WEAPONS

This is, of course, what the Assembly of the United Nations has instructed the Atomic Energy Commission to propose. There appears to me to be no alternative to it. I therefore consider it of the highest importance that the public opinion of this and other countries should be mobilized to support their Governments in pressing the view that there is no alternative objective to the complete elimination of atomic weapons and other weapons for mass destruction.

Given the will among the Great Powers, I do not myself believe that the technical problems of inspection and control present any great difficulties. These problems have been discussed in great detail particularly in the U.S.A. and many valuable suggestions have been made.

It is very necessary to remember that wars cannot be won by atomic weapons alone. A small nation which by deliberate evasion secretly made atomic bombs and used them in an unheralded attack on some other power, would quickly be defeated by the overwhelming power of the United Nations using normal weapons. Thus a rogue attack of this kind would be a sure way for a small nation to commit suicide.

Only on the assumption of the decision (a) not to prepare for war against another great power and (b) to eliminate from our Armed Forces all major weapons adaptable to mass destruction, is it possible to envisage a rational approach to the urgent problem of the size and type of armed forces that this country needs.

If we in the United Kingdom in the present world situation do arm against other great powers then the sky is the limit: the result will be extreme poverty even without war, and probably destruction in the event of war.

It is clearly necessary to admit that there are difficulties in achieving all at once the complete elimination of atomic weapons. For one thing, these weapons exist now in the U.S.A. in appreciable numbers. Innumerable reports, particularly from our American Scientific colleagues, testify to the acute consciousness of the difficulty in which they are placed. We here are full of admiration for the courage and clarity with which the issues are continually being discussed in the newspapers, and in meetings of all kinds in the U.S.A., not to mention the voluminous and most interesting reports of the Senate and House Committees.

I have mentioned several times the great upheaval of American scientific and intellectual opinion which has been brought into being by the Atomic Bomb. First local Atomic Scientists Committees were formed to discuss the implications and to educate the public. These later gave rise to a wider body called the Federation of American Scientists. Those bodies have issued a number of most valuable reports.

The discussion is understandably much franker than it has been in this country. For instance General Groves expressed the view "we have to keep operating everything from the standpoint of having a sufficient supply of bombs on hand until somebody makes up his mind as to what is to be the future of this work".

We have argued that it is peculiarly in the interest of Great Britain to achieve the general abolition of atomic weapons. We must, therefore, support our Government in every way in pressing for the most rapid achievement of our major objective, the elimination of weapons of mass destruction from the armoury of all nations.

The world food crisis which now confronts us with such intensity must provide an added spur to our efforts for there is no doubt—except perhaps in the U.S.A.— that the economic effort involved, if the Great Powers arm against each other, will seriously impede economic recovery.

The choice for each nation is not only whether to devote their scarce and scientific technical resources to Atomic Bombs or Atomic Power, that is to destruction or construction, but whether we are to allow the discovery of Atomic Bombs to poison international relations and reduce standards of life by diversion of industrial efforts to increased armaments in general.

A Scientist's Visit to England and France . *J. A. Simpson, J*

A conference on "Science and the Welfare of Mankind" was held in London on February 15-17. Many foreign scientists came to this meeting as representatives of groups within their own countries. It was my privilege to attend it as observer for the Atomic Energy Committee of the Carnegie Endowment for International Peace and as representative of the Federation of American Scientists. This visit provided an opportunity to spend two weeks talking with scientists, government officials and other representative citizens in England, Scotland and France. I have attempted to gain in this way a picture of what the British and other Europeans think regarding the politically loaded problems of atomic energy and to describe to them the activities of the scientists in the United States.

CONFERENCE ON "SCIENCE AND THE WELFARE OF MANKIND"

Although plans for the conference had been under consideration by the British Assn. of Scientific Workers, since Nov. 1945, no preparations were made in America to send representation to London until the week before the conference. Scientists in America strongly believed that an international conference of scientists would be conducive to improved international relations; however, some feared that this conference would lack adequate foreign representation, particularly from Russia. When it became evident at the last moment that several nations would be represented—even though no Russian scientists had accepted the invitation—the Federation of American Scientists decided to send a representative and the Carnegie Endowment generously provided financial backing.

The fact that the President of the Royal Society was chairman and that the conference was opened by the Lord President of the Council, testified to the stature which the A.Sc.W. had attained in Britain.

Only representatives from China, South Africa, Holland, France, Canada, United States and Great Britain were heard in the opening session; representatives from Belgium, Czechoslovakia, and Poland were also present.

At the opening session Prof. Oliphant discussed the urgency of developing peacetime atomic energy power plants in the British Empire. Due to the decreasing supply of good coal and the difficulty of obtaining miners, Britain may face a serious fuel shortage within the next generation. In addition, with the help of atomic power, the colonies and the dominions would be able to develop local industries and greatly improve Britain's economic status. This point of view is important in understanding what Britain may do in the field of atomic energy. The urgency of the problem cannot be realized fully by a nation like the United States which has almost unlimited supplies of energy, and adequate manpower. The rapid development of atomic energy is considered by many in Britain to be essential for its survival as a major power; it is not an urgent problem in the United States because it would affect our economy only slightly.

The second session, on February 16, "The Responsibilities of Scientists in Modern Society", opened with a talk by Professor A. V. Hill, which was reprinted in the last issue of the **Bulletin**. In this speech, the problem of ethics in the application of science to human affairs was raised as a vital issue for all scientists.

The final session on February 17, was originally planned to be devoted to the organization of science on a national and international scale; but as the conference opened it was announced that most of this session would be devoted to atomic energy. Some effort had been made throughout the conference to treat the atomic bomb as only one part of the problems facing science, but again and again the bomb crept into the discussions.

Professor P.M.S. Blackett presented interesting arguments in favor of retaining the veto power in the Security Council despite the development of such weapons as the atomic bomb. The speech, which is reprinted in condensed form elsewhere in this issue, was received with considerable approval in London.

Professor Joliot, just appointed High Commissioner for Atomic Energy in France, attacked the U. S. policy on secrecy:

"I consider as very dangerous," he said, "the position taken by the United States during recent talks, because keeping the secrets of the atomic bomb appears as a means of pressure. What is serious is that it should henceforth be possible to keep secret the results obtained by scientific research in nuclear physics. It would thereafter be impossible to visit laboratories, to maintain normal relationship with colleagues and old friends, with whom we have for so long collaborated despite distances and frontiers...Once the principle of secrecy has been accepted, there is no reason why it should not be extended to all fields of science."

The conference was remarkable not only for the high level of the ideas presented by the speakers, but also as a demonstration of the extent to which social implications of science are studied and appreciated in England. The social awareness of scientists existed in Britain for many years before it first developed in the Uni States. Beaver Hall was filled to capac at all sessions and the response and co ments from the floor indicated the inter interest of the audience. Editorials in leading papers of Britain, during the d of the conference, showed a keen inter of the country in the problems discuss

ORGANIZATIONS OF SCIENTISTS IN FOREIGN COUNTRIES

A meeting was organized by the Soci for Visiting Scientists on February 16, which scientists of various foreign co tries described briefly the organizati which they represented.

1. **The British Association of Scienti Workers.** This is a union which is clos ly allied with other labor unions in t United Kingdom. Its membership i cludes not only scientists but technicia and laboratory workers in all types industrial and government laborator in England. Aside from their gener interest in the responsibility of scien in the modern world, they are also vit ly concerned with the maintenance adequate wages and satisfactory wor ing conditions for the members. T membership is approximately 18,0 Politically, the organization is consi ered as "left of center." Several co mittees of the B.A.Sc.W. act as adviso to the present government. Its presti in Britain is much higher than any as ciation of scientific workers enjoys in a other country.

2. **Holland.** Professor J. M. Burge reported on the considerable interest the Dutch scientists in social and poli cal implications of recent developme in science. There is no organization Holland at the present time which wo give expression to this interest. Pr fessor Burgers, who is also secretary the Committee on Science and Soc Relations of the International Coun of the Scientific Unions, will proba take a lead in establishing such an ganization.

3. **Czechoslovakia.** Dr. Juroslav Ber of the University of Prague report that only national societies for scienti in specialized fields exist in Czechos vakia at present. These groups ha made some attempt to formulate vie on the implications of atomic ener Plans are being made for a stable ganization of scientists in Czechos vakia.

4. **South Africa.** Miss Cooke report on the South African Association of S entific Workers. They are split into t groups—one in Capetown, and one Johannesburg. They are making eve

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rt to stay out of politics so that they y act as advisors to the government. ause employers also belong to the anization, it is very unlikely that they ever become a trade union.

. China. Dr. T'u Chang-Wang re-ted for the Chinese Association of entific Workers. This organization existed about six months. Its main phasis is on problems of creating nocracy in China. The two functions he Association are to advise the gov-ment on economic problems, and to rt political pressure for the benefit cience. Unlike associations of scien- workers in other countries, the Chi-e feel that economic bargaining for r own benefit, means loss of face. Chinese parliament asks the advice their science committees, and one of r Association's most recent successes been the development of an insur-e program for its members.

Belgium. Dr. Max Cosyns pointed that there is no organization in gium corresponding to those in other ntries nor is there likely to be in the nediate future because an official sci-e committee has been appointed to y out all of the activities which ld normally be carried by these ups. A Belgian nuclear energy com-sion of which Dr. Cosyns is a mem- will soon be functioning.

France. Messrs. Bonet-Maury and . Mathieu reported for L'Association Travailleurs Scientifiques, and de-bed the difficulties and the progress le by the relatively young association heir country. At the present time, organization depends heavily upon a tively few very enthusiastic mem-, rather than upon a broad member- (from Prof. Auger, I inferred that and other government officials were e sympathetic with the ATS, but felt ; it would not be effective as long as s not connected in some official way n the government and its activities).

Australia. The Australian Associa- of Scientific Workers is six years and has a membership of approxi-ely six hundred. It does not carry ny trade union activities.

Canada. Dr. Grant Lathe spoke for Canadian Association of Scientific rkers, saying that it was more like a e union in character than most of other groups. Otherwise, the char-ristics of the Canadian and Ameri- Association of Scientific Workers ned to be approximately the same.

). Poland. Professor Ossowski re-ed that only specialized scientific anizations were at present in any active in Poland. However, he was rested in the establishment of an anization combining the interests of social scientists with those of the natural scientists.

11. It was reported at the meeting that **India** was just beginning to form what may become an Association of Scientific Workers.

12. **New Zealand** has an Association of Scientific Workers, but no information was available on it at the meeting.

13. **United States.** A report was presented on the activities of the Federation of American Scientists and is member organizations. It was pointed out that the Federation was not organized with any program for the benefit of the scientists and that the constitution of the Federation precludes such activities and concentrates at least for the time being, on problems of international control of atomic energy. It was pointed out that there is no relationship in America between the Federation and groups which have any political bias. It was stated that this would not preclude the cooperation of the Federation on an international level with organizations which have somewhat broader aims. The restriction of the membership of the Federation to active scientists and graduates in fields of science was pointed out as different from qualifications required by many other organizations which had been described. The functions of the National Committee on Atomic Information and the activities of various study groups were described, such as the Carnegie Committee on Atomic Energy, the Office of Inquiry on Atomic Energy at Chicago, and the Denver Conference Committee. There were no representatives for the American A.Sc.W., but a letter from its President, Dr. Grundfest, was transmitted to the secretary of the British A.Sc.W.

From this survey of organizations in various countries, it became evident that an international organization could be formed from these groups, if it were restricted to the broadest aims of world security and an understanding of the implications of science for society. This resulted in a second meeting at which definite proposals were adopted for an international conference to be held this summer in London.

BAScW COMMITTEE ON ATOMIC ENERGY

There is an official Atomic Energy Committee in Great Britain directed by Sir John Anderson (popularly called the Anderson Committee.) Professors Blackett, Peierls and Dee are among the nuclear scientists who are members. This Committee reports to the government only.

The British A.Sc.W. formed a committee of atomic scientists during January, composed of both members and non-members of the Association, from university and industrial laboratories. The chairman of the Committee is Prof. H. S. W. Massey, F.R.S., University College, London; it includes, among others, Prof. J. D. Bernal, F.R.S. (Birkbeck College, London). Prof. P.M.S. Blackett, F.R.S. (London), Prof. N. F. Mott, F.R.S., (Bristol University), Prof. M.L.E. Oliphant (Univ. of Birmingham), Prof. R. E. Peierls, F.R.S., (Univ. of Birmingham), and Dr. H. W. B. Skinner, F.R.S., (Ministry of Supply, Directorate of Atomic Energy).

I met with the Committee on February 23, and presented a rather complete report of all activities of the new scientists organizations in America. I found that their committee was very much in accord with our course of action. I offered space in our news bulletins so that other nations could circulate information on various activities associated with the study of atomic energy control.

Dr. Kürti of the Clarendon Laboratory at Oxford reported on a meeting held two weeks earlier at which over fifty Oxford scientists assembled to discuss the formation of an organization similar to the ones in the United States. Professors Massey, Mott, Peierls and Oliphant were in favor of isolating to some extent the Atomic Energy Committee from the British Association of Scientific Workers. I assume from the discussions at this meeting that the Atomic Energy Committee will rapidly expand to include scientific groups from universities throughout the country.

It is highly important that those of us in the United States help this committee establish a favorable climate of public opinion in Britain as soon as possible. I would judge that the British group is about at the same stage of development as we were in the United States in late August, 1945, except that their representative scientists are much closer to the government.

One reason why organizations or committees on atomic energy did not develop in Great Britain at about the same time as they did in the United States lay principally in the fact that most of the British nuclear scientists were at that time government advisors, or were outside their country when the atomic bomb was dropped and, therefore, were not free to speak.

On behalf of the Federation of American Scientists I wish to extend sincere appreciation to Dr. James T. Shotwell and the Carnegie Endowment for International Peace. They made it possible for an American scientist to attend the conference in London and to meet the scientists of other nations. I could not help but feel that this visit was warmly welcomed by all the scientists whom I met in England and France.

Association of Northern California Scientists

The most vigorous addition to the numerous scientific groups, emerging throughout the country to combat the menace of the atomic bomb, is the Northern California Association of Scientists. The Association was formed on December 7, 1945, by scientists from Stanford, San Francisco and Berkeley.

The sponsors are:

Thomas Addis, Professor, School of Medicine, Stanford; Otto Beeck, Associate Director, Shell Development Company; Raymond T. Birge, Chairman, Department of Physics, U. C.; Melvin Calvin, Professor of Chemistry, U. C., Manhattan District Project; Willard C. Fleming, Dean of College of Dentistry, Associate Professor of Operative Dentistry, San Francisco; Joel H. Hildebrand, Professor of Chemistry, U. C.; F. A. Jenkins, Manhattan District Project, Professor of Physics, U. C.; Paul L. Kirk, Professor of Biochemistry, U. C., formerly of the Manhattan District Project; Paul Kirkpatrick, Professor of Physics, Stanford; James W. McBain, Professor of Chemistry, Stanford; Jerzy Neyman, Head of Statistical Division, Department of Mathematics, U. C.; M. P. O'Brien, Dean of the College of Engineering, U. C., formerly of Manhattan District Project; Frank Oppenheimer, Manhattan District Project, Radiation Laboratory, U. C.; Kenneth S. Pitzer, Professor of Chemistry, U. C.; Milton J. Polissar, Department of Chemistry, S. F. Junior College; Gerhard K. Rollefson, Professor of Chemistry, U. C., formerly of Manhattan District Project; Robert Serber, Manhattan District Project, Radiation Laboratory, U. C., formerly Professor of Physics, University of Illinois; Ernest G. Sloman, Dean of College of Physicians and Surgeons, School of Dentistry, San Francisco; Otto Stern, Professor Emeritus, Nobel Laureate, Physsic; William E. Vaughan, Past Chairman, California Section, American Chemical Society.

A meeting held in San Francisco on March 1 and attended by about 2000 scientists was addressed by Prof. J. H. Hildebrand and Prof. P. L. Kirk. Prof. Hildebrand, who was Commandant of the Gas School in France during World War I and Liaison Officer of the OSRD in London during World War II, sharply attacked Gen. Groves' views on domestic legislation and illustrated from his extensive experiences his belief that the army is incapable of supervising research in such a pioneer field as nuclear physics. Thousands of signatures were obtained for petitions supporting the original McMahon Bill S 1717.

The Association has helped organize the important lay organizations of Northern California into an Emergency Committee for Civilian Control of Atomic Energy similar to those in Washington and Chicago.

Dr. M. J. Pollisar has written a brochure detailing methods of coordinating scientific groups throughout the country for the mobilization of informed opinion on the problems of Atomic Energy.

Labor Leaders and Atomic Scientists Meet

Meeting together for the first time in their history, labor and science jointly resolved Monday (April 1) at a one-day conference at the University of Chicago to bring the uses and control of atomic energy to the attention of the American worker.

The conference was the second in a series of joint sessions at which Atomic Scientists of Chicago are meeting with church, labor and business leaders.

The 50 labor leaders, representing middlewestern and Washington, D.C. district labor organizations, made two resolutions at the close of the conference, which was sponsored by the Industrial Relations Center and the University College of the University in cooperation with the Atomic Scientists of Chicago.

The resolutions unanimously adopted by the labor delegates were: (1) to set up a continuing committee to study the industrial aspects of atomic energy, and (2) to appoint a committee of 18 members to recommend to national labor heads the appointment of a joint labor-science committee on atomic energy. The committee would include members of the American Federation of Labor, the Congress of Industrial Organizations, the Railroad Brotherhoods, and the Atomic Scientists.

A similar joint committee of religious leaders, including representatives of Protestant, Catholic and Jewish faiths, and atomic scientists was set up after the previous midwestern religious conference. This committee has been devoting itself to the development of educational programs on the problems of atomic energy.

The conference delegates, representatives of four million organized workers, were told the story of the development of the atomic bomb by Reuben G. Gustavson, vice-president of the University of Chicago. The future developments of atomic energy were discussed by A. M. Weinberg, theoretical physicist at Clinton laboratories, Oak Ridge, Tennessee.

Principal speaker on the afternoon panel and dinner program was Harold C. Urey, Nobel-prize chemist and professor of chemistry at the university.

Prof. Urey urged the labor leaders to aid the scientists with their fight against military control of atomic research, and in particular to take cognizance of the legislation which is now before Congress, and to inform workers in all unions to support a bill putting atomic control in civilian hands.

Victor A. Olander, secretary of the Illinois Federation of Labor, said of the conference, "We have heard one of the most terrifying stories ever told to a labor group."

National Committee for Civilian Control Announce[d]

The formation of a National Commit[tee] for Civilian Control of Atomic Energy [was] announced at Washington on March [...] The Committee, which includes pers[ons] eminent in many fields, will actively [op]pose all efforts to place control of ato[mic] energy in military hands.

Members include Donald M. Nelson, Presiden[t of] the Society of Independent Motion Picture Pro[duc]ers; Arthur D. Whiteside, President of Dunn [&] Bradstreet; Percival F. Brundage, senior part[ner] Price Waterhouse and Co.; Herbert H. Lehm[an,] former Governor of New York; Leo Cherne, [Re]search Institute of America; E. R. Embrie, Pr[esi]dent, the Rosenwald Foundation; Mrs. John A[.] Carpenter, Chicago civic leader; Gifford Pin[chot,] former Governor of Pennsylvania; Marshall F[ield,] Publisher; the Rev. Harry Emerson Fos[dick,] Minister, Riverside Church, New York; Leon [Hen]derson, former Director of O.P.A.; Mrs. J. Bo[rden] Harriman, former U. S. Minister to Norw[ay;] Maurice Harrison, Attorney, San Francisco; [the] Rev. John Haynes Holmes, Pastor, Commu[nity] Church, New York; Stringfellow Barr, Presi[dent,] St. John's College; Walter White, President, [Na]tional Association for Advancement of Colored [Peo]ple; Melvin D. Hildreth, Attorney, Washing[ton;] Cass Canfield, President, Harper Brothers; A[lex]ander Sachs, economist, New York; Robert [M.] Hutchins, Chancellor, University of Chicago; [the] Most Reverend Bernard J. Shiel, Auxiliary Bi[shop] of Chicago of the Roman Catholic Church; Bea[rds]ley Ruml, President, Macy and Company; Sum[ner] Welles, former Under Secretary of St[ate;] C. A. Dykstra, Provost of the University of [Cali]fornia in Los Angeles; Bishop G. Bromley Ox[nam] of the Methodist Church, President of the Fe[deral] Council of Churches of Christ in America; Ge[orge] Thomas, Salt Lake City, former President of [the] University of Utah; Thomas K. Finletter, A[ttor]ney, New York; Ralph Flanders, Chairman, [Fed]eral Reserve Bank, Boston; Jock Whitney, Pa[yson] Hoyt and W. H. Vanderbilt.

In a statement of purpose, the Com[mit]tee said it would "support legislative [and] executive measures placing active con[trol] of this new force in a civilian agency [re]sponsible to the President and Congre[ss."]

NO INSURANCE FOR ATOMIC BOMB VICTIMS

The British Sun Life Assurance S[ocie]ty has announced that its future life [in]surance policies will exclude responsib[ility] in case of deaths caused by atomic bo[mbs.]

Errata

The article "Uranium in Nature" w[hich] appeared in issue No. 5 unfortuna[tely] contains a misprint in the average [per]centage of uranium in the earth's c[rust.] The correct value is 0.0004% (or 4 p[arts] per million of igneous rock), instea[d of] 0.004%.

The article "Atomic Power Product[ion]" by Farrington Daniels in issue No. 7 [con]tains a misprint which was correcte[d in] some of the copies. The correct esti[mate] for the price at which U-235 or pluto[nium] can compete economically with coa[l is] \$25,000 per lb.; not \$25,000 per g[ram.] Similarly the competition price with [res]pect to gasoline, should be \$50,000 [per] lb., instead of per gram.

urrent Status of Domestic Legislation . . . .

(Continued from page 1)

ground. Similar Committees were or-
zed in the Middle West (Chicago) and
he West (San Francisco). Opposition
he original text of the amendment has
ived support from such quarters as the
it President of Loyola University in
ago and a Navy spokesman, Admiral
en.

wo large and very successful rallies of
and religious leaders were held at
nd Rapids and Flint, Michigan (the
one the home town of Sen. Vanden-
) on March 20 and 22, as sequels to
Middle Western Conference of religious
ers with the Atomic Scientists of Chi-
in February. These events in his own
e state did not remain unknown to
tor Vandenberg.

nally, it became known that General
nhower, representing the Joint Chiefs
taff, does not favor the kind of mili-
supervision board suggested by Van-
erg. In an interview with Prof. Hog-
General Eisenhower expressed him-
as follows:

) He is in favor of civilian control,
the provision that there shall be
on, working both ways, between civil-
atomic energy commission and the
ary.

) He thinks it not necessary to deter-
in the bill the detailed mechanism of
iaison, because a military board will
access to the Secretaries of War and
, who in turn will be in a position to
up with the President such matters
ll within the scope of their respective
rtments.

) With regard to security all he wants
surance that adequate measures will
aken against any traitors who sold
or processes to foreign agents.

) It was his hope that world control
omic energy would materialize, but he
hat until such control was assured it
his duty as Chief of Staff to see to it
the military was cognizant of all
ant developments in this field.

ese events paved the way for a com-
ise in the matter of liaison between
ivilian atomic energy commission and
rmed Forces. Two suggestions were
. One—which revived a scheme sug-
d in Senator Ball's bill—was to make
Secretaries of the Army and Navy
perhaps those of State and Commerce
ell) ex-officio members of the Atomic
gy Commission. The other suggestion
to reduce the military board to the
rtion of a true liaison board, sub-
ating it to the Secretaries of the
and the Navy.

e first suggestion, favored by the Na-
as taken up by Sen. McMahon, and Sen. Johnson of Colorado offered to support it. However, strong opposition exists to this solution on the ground that the Secretaries (or Assistant Secretaries) are too busy to take active part in the deliberations of the Commission.

The second alternative—a military liaison board with reduced powers, was preferred by Gen. Eisenhower, and appeared acceptable to the scientists as well. As a result of discussions with Sen. Vandenberg, the following changed version of the amendment was introduced and adopted unanimously by the Senate Committee on April 2:

"There shall be a Military Liaison Committee consisting of representatives of the Departments of War and Navy, detailed or assigned thereto, without additional compensation, by the Secretaries of War and Navy in such numbers as they may determine. The Commission shall advise and consult with the Committee on all atomic energy matters **which the Committee deems to relate to military applications, including the development, manufacture, use and storage of bombs, the allocations of fissionable materials for military research and the control of information relating to the manufacture or utilization of atomic weapons. The Commission shall keep the Committee fully informed of all such matters before it, and the Committee shall keep the Commission fully informed of all atomic energy activities of the War and Navy Departments.** The Committee shall have authority to make written recommendations to the Commission on matters relating to military applications from time to time as it may deem appropriate. If the Committee at any time concludes that any action, proposed action or failure to act of the Commission on such matters is adverse to the responsibilities of the Departments of War or Navy as derived from the Constitution, laws and treaties, **the Committee may refer such actions, proposed actions or failure to act to the Secretaries of War or Navy.** If either Secretary concurs, he may refer the matter to the President, whose decision shall be final."

The essential improvements on Vandenberg's original text are: (1) that the liaison committee is appointed by and reports to, the Secretaries of War and Navy, and not directly to the President, as in the old version; (2) that the matters of concern to the liaison committee are defined as those "relating to military applications"; and (3) that the Committee is to be "kept fully informed by the Commission on all such matters" (i.e. matters relating to military applications) instead of the original provision that it "shall have all opportunity to acquaint itself with all matters before the Commission" (which seemed to imply the right to inspect all papers, and supervise all laboratories and plants under the jurisdiction of the Commission). In addition, the information provision is now to work both ways.

A weakness of the present text is that it leaves the final say as to what "relates to military applications" to the decision of the military committee. Despite an attempt to circumscribe the scope of this term in text of the amendment, a door is left open here for arbitrary interpretation. This loop-hole may become particularly dangerous in connection with the allocation of fissionable materials and control of information. The military committee may try to argue, for example, that large sections, or even the whole, of nuclear physics is "information relating to the manufacture of bombs." It is therefore very important to scrutinize closely the provisions for allocation of fissionable materials, the dissemination of information, and security regulations in other parts of the bill. This scrutiny will probably only become possible after the bill is reported out of the Committee to the Senate. Continued campaign is necessary to circumscribe as precisely as possible the field in which the military shall retain influence on allocation of materials and dissemination of scientific information.

Altogether, the fight for civilian control of atomic energy is by no means over. It will have to be carried on until good legislation has been passed by both the Senate and the House.

The scientists groups and the lay organizations, assisted by the more enlightened leaders in the Armed Forces, have succeeded in blocking—for the time being—the passage of one legislative provision which would have crippled our domestic research in nuclear physics and jeopardized the attempts to achieve international control of atomic energy and thus to prevent an atomic armament race. The fight for the bill as a whole is not over. It is however a good sign that the public opinion has begun to stir; wider and wider groups begin to realize the importance of the atomic energy problem. The McMahon Committee no longer works in an atmosphere of general indifference. In the last weeks, the mail of some members of the McMahon Committee has reached several thousand a day. Continued growth of public interest is the only firm basis for a sound national and international policy on the problems of atomic energy.

NAVY TEST POSTPONED

Postponement of the atomic bomb test at Bikini atoll, originally scheduled for May 15, was announced by President Truman on March 22. Truman's press statement said that the first two tests would be set beck approximately six weeks each.

The President's statement attributed the postponement to the heavy legislative calendar which would prevent many Congressmen from attending the tests if held on the original dates.

TRUMAN APPOINTS COMMITTEE TO REPORT ON BOMB TESTS

President Truman has announced the make-up of a nine-man civilian commission to report directly to him on the results of the atomic bomb tests now scheduled for July and August. The Committee consists of Senators Carl Hatch, New Mexico and Leverett Saltonstall of Massachussetts; Representatives Andrew J. May of Kenticky, and Walter G. Andrews of New York; Dr. J. Robert Oppenheimer of the California Institute of Technology, Bradley Dewey, wartime rubber director of the WPB and President of Dewey & Almy; William S. Newell, President of the Bath (Me.) Ironworks; and Fred Searls, Jr., New York mining engineer and special assistant to the Secretary of State.

"THE ATOMIC BOMB"

A second edition of "The Atomic Bomb", the ASC pamphlet, has just been printed. Copies are available at the following prices:

Single copy—25c; 10 or more copies—20c per copy; 100 or more copies—15c per copy; 500 or more—12½c per copy.

The Atomic Engineer and Scientist, published by the Oak Ridge Engineers and Scientists, has been discontinued and beginning with this issue the **Bulletin of the Atomic Scientists** will include the news coverage which has been furnished by the other publication. This move has been made because of the large degree of unanimity of outlook of the two groups at Chicago and the Oak Ridge. All persons who have been receiving the **Atomic Engineer and Scientist** will now receive the **Bulletin of the Atomic Scientists.**

Senator Ball on Control of Atomic Energy

I am opposed to the military control of atomic energy domestically which I believe the original May-Johnson bill would have brought about. It is understandable that many Americans, misled into believing that the only choice for us is between that bill and S. 1717, the McMahon bill introduced last January, should prefer the latter, despite its complete disregard of security aspects of this issue. Fortunately, there is a sound, liberal solution which will assure fundamental civilian control of atomic energy and freedom of research, without disregarding the important national security aspects of this whole problem.

There are five objectives in atomic energy control on which I believe most of us could agree. They are:

1. That government control of production and development in this tremendously important field be set up by legislation as soon as possible, so as to resume the progress in research which has come to a standstill because of the lack of legislation.

2. That the federal government, through a civilian commission, should control all fissionable materials, their production, and, through licensing and allocation powers, their use in research, industry and in the development and production of atomic weapons.

3. That fundamental research, as distinct from applied research, should be completely free, with scientists free to publish their findings.

4. That security precautions on atomic weapons continue until safe international controls may obviate their necessity, and that there should be joint military and civilian control and direction of atomic weapon research.

5. That the United States should vigorously support and lead in the efforts of the UNO atomic energy commission to develop a safe method for international control of this destructive force.

Because of my strong opposition to the type of control of atomic energy proposed in the May-Johnson bill, I introduced a bill on this subject, S. 1557, on November 6, 1945, embodying the first four objectives stated above. A great many scientists with whom I discussed it endorsed the bill. It now appears that the majority of the special committee are rewriting the McMahon bill to conform largely to these objectives. If that is done, I certainly shall support the committee bill in the Senate.

BARUCH APPOINTED TO UNO ATOMIC ENERGY COMMISSION

Bernard M. Baruch has been appoin[ted] by President Truman as the United Sta[tes] Representative on the United Nati[ons] Atomic Energy Commission. Bar[uch] named as his advisers John Hanc[ock,] Wall Street banker who worked with [him] on his rubber and post-war reports; F[er]dinand Eberhart, New York investm[ent] banker, lawyer, and former vice-ch[air]man of the War Production Board; H[er]bert Bayard Swope, publicist and jo[ur]nalist, who was Mr. Baruch's assistant [on] the War Industries Board in World W[ar] I; and Fred Searls, New York mining [en]gineer who was assistant to Mr. Eb[er]stadt on WPB, and is now consultant [to] Secretary of State Byrnes.

Baruch said such American scient[ists] as James B. Conant, President of H[ar]vard University, Dr. Vannevar Bush, [who] headed the Office of Scientific Resea[rch] and Development, and Dr. A. H. Co[mp]ton, Chancellor of Washington Unive[rsi]ty, "will give us the necessary scien[tific] guidance". General Leslie M. Groves [and] "those in American industry who h[ave] made a success of the use of atomic e[ner]gy" will be advisers on manufacture.

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BULLETIN OF THE ATOMIC SCIENTISTS

EDITORS:

H. H. Goldsmith **E. Rabinowitch**

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LETIN of the
ATOMIC SCIENTISTS . . .

. 1 APRIL 15, 1946 No. 9

he McMahon Bill and the ate Department Report

The twin foci of our interest remain the McMahon bill on nal regulation, and the Acheson-Lilienthal report on inter- nal control of atomic energy.

The bill has now been reported out of the Special Senate nittee to the floor of the Senate. The considerable changes additions which the original text has undergone as a re- of committee deliberations will require careful study.

As a basis for this study, we reprint in this issue a digest e bill, including the full text of the most important new tered provisions.

The first impression is that the bill, in its present state, compromise which provides a workable basis for research development in the field, particularly if a competent and endent Atomic Energy Commission is appointed.

* * *

The public response to the State Department Report has e whole been gratifying—ranging from cautious approval nthusiastic support. We reprint some authoritative com- s on pages 10 and 12. The attitude of the Atomic Scientists hicago has been expressed in the following statement, y adopted by the Executive and Advisory Committees:

"The Atomic Scientists of Chicago emphatically endorse main ideas and proposals in the State Department Com- e report on International Control of Atomic Energy.

"The report proposes a bold but workable solution; in- n and an unplanned drift into international competition l be much more dangerous. Instead of searching cautiously minimum of action, the report outlines an aggressive y of planned progress and international cooperation.

"The report recommends a multiplicity of safeguards which render evasion or violation of international control diffi- These safeguards include complete control of raw ma- s. and of the production of fissionable materials, by the national authority provisions for non-dangerous designs power-producing units in private or national hands, de- ing of dangerous materials, inspection of key plants, and nge of information on scientific and technical activities.

"No one of these proposals offers in itself complete safety. taken together, they constitute the best scheme one can e at this time.

"If the constructive and imaginative spirit of the State rtment report is compared with the 'Maginot-line' men- of 'keeping the secret,' one can hardly doubt in which tion the hope for safety lies."

* * *

The most powerful argument in support of the report s to be the question: what are the alternatives? One t of this question is illuminated by the article by Mar- Teller and Klein in thie issue. Not only a failure to lish an assured international control of atomic armaments o eliminate war as a possibility to be seriously reckoned in long-range national planning, but even a delay of a few in achieving these aims, will make drastic re-organization e whole economic and social life of the United States rgent matter of self-preservation.

Medical and Industrial Uses of Pile Products*

Tantalizing as the prospects of large-scale atomic power plants are, it may very well be that power will not be the most important product derived from the operation of atomic energy units ("piles"). The prospects of power are actually of less immediate importance than are the possibilities opened up through the production of radioactive substances even in small piles. In other words, piles will be useful and important for the production of radioactive substances and penetrating radiations even during the period in which power piles are not economically practical. Such radioactive substances have been made before, in minute amounts, by means of cyclotrons and similar apparatus, but the use of a pile will make possible the manufacture of tremendously larger amount of these materials. While all the uses of radioactive substances cannot be foreseen at the present time, enough work was done before the war with the tiny amounts available then to point out the directions future work may take.

GENERAL FIELDS OF USEFULNESS

Probably the most important uses of these new substances will be in the field of research—research in medicine and biology, in industrial processes, and in pure science. Developments in all of these fields will be greatly accelerated, for the availability of large amounts of radioactive substances will put into the hands of research men a new and most powerful tool—one which will make possible the gathering of knowledge unattainable by any other means. Radioactivity gives promise of being as important to medical and biological research as was the microscope, as important to chemical research as was the chemical balance, and as important to physical research as was the spectroscope.

In this new era of rapid scientific and technological development, the acceleration of all kinds of research means that advances in the well-being of man will be made more rapidly, that cures for diseases will be discovered more rapidly, and that new products and materials will be developed, which may give rise to great new industries comparable in size and importance to the synthetic rubber, the plastics, or the light metals industries.

From discoveries made before the war, it was already evident that radioactive substances will find direct use in medicine for the treatment of certain diseases, and that in industry they will enable many processes to be carried on more efficiently and economically.

RADIATIONS AND SUBSTANCES PRODUCED BY A PILE

Thick concrete or steel shields are built around piles as protection against their intense gamma and neutron radiations, similar to those which injured and killed so many people in the atomic explosions at Hiroshima and Nagasaki. These radiations can be made available for controlled medical or industrial use through ports cut in the shielding. The radiation is emitted as a beam through these ports. The use of these radiations is confined to the vicinity of the pile. It is an important extension of the usefulness of the pile that it can also be used to manufacture highly concentrated portable sources of penetrating radiations.

(Continued on page 16)

* Reprinted from "The Atomic Bomb," by the Atomic Scientists of Chicago, Chicago, 1946.

THE REVISED McMAHON BILL . . .

The Bill, S. 1717, which was reported out by the Senate Special Committee on Atomic Energy on April 11, is based on the draft introduced on December 20 of last year by Senator McMahon. However, it has been changed in many important provisions, and has grown to almost double its initial size as a result of the Committee deliberations. We print the official digest of the current version, presenting the full text of the most important provisions, particularly those which distinguish the present bill from the original McMahon draft. These sections are printed in different type to set them off from the rest.

POLICY (SEC. 1)

It is declared to be the policy of the people of the United States that the development and utilization of atomic energy is to be directed toward improving the public welfare, increasing the standard of living, strengthening free competition among private enterprise and promoting world peace. This policy is at all times subject to the paramount objective of assuring the national security.

To carry out these objectives this bill provides for Government control of the production, ownership and use of fissionable material and for programs of information, production, research and development. It establishes an administrative agency to exercise this control and promote this development subject to international agreements of the United States and to such further legislation as the Congress may enact. It is noted that legislation passed at this time will undoubtedly need reconsideration and change from time to time.*

ORGANIZATION (SEC. 2)

A. Atomic Energy Commission

(1) There is hereby established an Atomic Energy Commission (herein called the Commission), which shall be composed of five members. Three members shall constitute a quorum of the Commission. The President shall designate one member as Chairman of the Commission.

(2) Members of the Commission shall be appointed by the President, by and with the advice and consent of the Senate. In submitting any nomination to the Senate, the President shall set forth the experience and the qualifications of the nominee. The term of office of each member of the Commission taking office prior to the expiration of two years after the date of enactment of this Act shall expire upon the expiration of such two years. The term of office of each member of the Commission taking office after the expiration of two years from the date of enactment of this Act shall be five years, except that (A) the terms of office of the members first taking office after the expiration of two years from the date of enactment of this Act shall expire, as designated by the President at the time of appointment, one at the end of three years, one at the end of four years, one at the end of five years, one at the end of six years, and one at the end of seven years, after the date of enactment of this Act; and (B) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed, shall be appointed for the remainder of such term. Any member of the Commission may be removed by the President for inefficiency, neglect of duty, of malfeasance in office. Each member, except the Chairman, shall receive compensation at the rate of $15,000 per annum; and the Chairman shall receive compensation at t[he] rate of $17,500 per annum. No member of the Commissi[on] shall engage in any other business, vocation, or employme[nt] than that of serving as a member of the Commission.

(4) There are hereby established within the Commission

(A) A General Manager, who shall discharge such of t[he] administrative and executive functions of the Commission [as] the Commission may direct. The General Manager shall [be] appointed by the President by and with the advice and c[on]sent of the Senate, and shall receive compensation at t[he] rate of $15,000 per annum. The Commission may make reco[m]mendations to the President with respect to the appointme[nt] or removal of the General Manager.

(B) A Division of Research, a Division of Production, [a] Division of Engineering, and a Division of Military Appli[ca]tion. Each division shall be under the direction of a Direc[tor] who shall be appointed by the Commission, and shall [re]ceive compensation at the rate of $14,000 per annum. T[he] Commission shall require each such division to exercise su[ch] of the Commission's powers under this Act as the Comm[is]sion may determine, except that the authority granted un[der] section 3 of this Act shall not be exercised by the Division [of] Research.

B. General Advisory Committee

There shall be a General Advisory Committee to [ad]vise the Commission on scientific and technical matters [re]lating to materials, production, and research and developme[nt], to be composed of nine members, who shall be appoin[ted] from civilian life by the President. Each member shall h[old] office for a term of six years, except that (1) any mem[ber] appointed to fill a vacancy occurring prior to the expira[tion] of the term for which his predecessor was appointed, s[hall] be appointed for the remainder of such term; and (2) [the] terms of office of the members first taking office after [the] date of the enactment of this Act shall expire, as designa[ted] by the President at the time of appointment, three at [the] end of two years, three at the end of four years, and th[ree] at the end of six years, after the date of the enactment [of] this Act. The Committee shall designate one of its own m[em]bers as Chairman. The Committee shall meet at least [...] times in every calendar year. The members of the Commi[ttee] shall receive a per diem compensation of $50 for each [day] spent in meetings or conference, and all members shall [re]ceive their necessary traveling or other expenses while [en]gaged in the work of the Committee.

C. Military Liaison Committee

There shall be a Military Liaison Committee consis[ting] of representatives of the Departments of War and Navy, [de]tailed or assigned thereto, without additional compensat[ion], by the Secretaries of War and Navy in such number as [they] may determine. The Commission shall advise and co[nsult] with the Committee on all atomic energy matters which [the] Committee deems to relate to military applications, inc[lud]ing the development, manufacture, use, and storage of bo[mbs], the allocation of fissionable materials for military resea[rch], and the control of information relating to the manufac[ture] or utilization of atomic weapons. The Commission shall k[eep] the Committee fully informed of all such matters befor[e] and the Committee shall keep the Commission fully infor[med]

*Section b(5) of the original draft, which added to the purposes of the act "a program for simultaneous study of the social, political and economic effects of the utilization of atomic energy" has been deleted.

ll atomic energy activities of the War and Navy Depart-ts. The Committee shall have authority to make written ommendations to the Commission on matters relating to ary applications from time to time as it may deem ap-oriate. If the Committee at any time concludes that any on, proposed action, or failure to act of the Commission such matters is adverse to the responsibilities of the De-rments of War or Navy, derived from the Constitution, , and treaties, the Committee may refer such action, pro-ed action, or failure to act to the Secretaries of War and y. If either Secretary concurs, he may refer the matter he President, whose decision shall be final.

RESEARCH (SEC. 3)

A. Research Assistance

The Commission is directed to exercise its powers in such ner as to insure the continued conduct of research and elopment activities in the fields specified below by pri- or public institutions or persons and to assist in the ac-ition of an ever-expanding fund of theoretical and prac- knowledge in such fields. To this end the Commission uthorized and directed to make arrangements (including racts, agreements, grants-in-aid, and loans) for the con- of research and development activities related to—

(1) nuclear processes;

(2) the theory and production of atomic energy, includ- processes, materials and devices related to such produc-;

(3) utilization of fissionable and radioactive materials for ical, biological, health, or military purposes;

(4) utilization of fissionable and radioactive materials and cesses entailed in the production of such materials for other purposes, including industrial uses; and

(5) the protection of health during research and pro-ion activities.

B. Research by the Commission

The Commission is authorized and directed to conduct, ugh its own facilities, activities and studies of the types cified in sub-section (A) above.

RODUCTION OF FISSIONABLE MATERIAL (SEC. 4)

The commission is required to own and operate all facilities the production of fissionable material. Management con-ts are permitted; private ownership or operation is express-orbidden, except for facilities producing small amounts in-nt to research and development which are not sufficient roduce an atomic bomb or other atomic weapon. In cases re the commission certifies to the Comptroller General that necessary in the interest of common defense and security, commission may make contracts without advertising for petitive bids.

CONTROL OF MATERIALS (SEC. 5)

A. Fissionable Materials

(1) Definition. — As used in this Act, the term "fission- material" means plutonium, uranium enriched in the ope 235, any other material which the Commission de-ines to be capable of releasing substantial quantities of gy through nuclear chain reaction of the material, or any erial artificially enriched by any of the foregoing; but s not include source materials, as defined in section 5

(2) Government Ownership of all Fissionable Material. — right, title, and interest within or under the jurisdiction he United States, in or to any fissionable material, now or hereafter produced, shall be the property of the Commission, and shall be deemed to be vested in the Commission by virtue of this Act. Any person owning any interest in any fissionable material at the time of the enactment of this Act, or owning any interest in any material at the time when such material is hereafter determined to be a fissionable material, or who lawfully produces any fissionable material incident to privately financed research or development activities, shall be paid just compensation therefor. The Commission may, by action consistent with the provisions of paragraph (4) below, authorize any such person to retain possession of such fissionable material, but no person shall have any title in or to any fissionable material.

(3) Prohibition. — It shall be unlawful for any person, after sixty days from the effective date of this Act to (A) possess or transfer any fissionable material, except as authorized by the Commission, or (B) export from or import into the United States any fissionable material, or (C) directly or indirectly engage in the production of any fissionable material outside of the United States.

(4) Distribution of Fissionable Material. — Without prejudice to its continued ownership thereof, the Commission is authorized to distribute fissionable material, with or without charge, to applicants requesting such material (A) for the conduct of research or development activities either independently or under contract or other arrangement with the Commission, (B) for use in medical therapy, or (C) for use pursuant to a license issued under the authority of section 7. Such material shall be distributed in such quantities and on such terms that no applicant will be enabled to obtain an amount sufficient to construct a bomb or other military weapon. The Commission is directed to distribute sufficient fissionable material to permit the conduct of widespread independent research and development activity, to the maximum extent practicable. In determining the quantities of fissionable material to be distributed, the Commission shall make such provisions for its own needs and for the conservation of fissionable material as it may determine to be necessary in the national interest for the future development of atomic energy. The Commission shall not distribute any material to any applicant, and shall recall any distributed material from any applicant, who is not equipped to observe or who fails to observe such safety standards to protect health and to minimize danger from explosion or other hazard to life or property as may be established by the Commission, or who uses such material in violation of law or regulation of the Commission or in a manner other than as disclosed in the application therefor.

B. Source Material

Source material is defined as meaning uranium, thorium or any other material which the commission considers to be essential to the production of fissionable materials, including ores if they contain any of the foregoing materials in such concentrations as the commission may determine. Transfer or possession of source materials after removal from place of origin in nature will be by license only. The commission may require reports of ownership, possession, extraction, refining and shipment of source materials after removal from place of origin but not in cases where quantities are unimportant or reporting will discourage independent prospecting.

The commission is authorized to acquire, through purchase, requisition, condemnation or otherwise, supplies of source ma-

terial or any interest in real property containing deposits of source material. Just compensation will be made for all property acquired. It may also carry on such exploratory operations, with the consent of the owners involved, and may carry out investigations and inspections for source material with or without the consent of the owners involved.

All source materials in deposits in public lands are reserved to the United States and source materials privately mined in such lands, unless in unimportant amounts, become the property of the commission in return for just compensation.

C. By-Products

(1) Definition. — As used in this Act, the term "by-product material" means any radioactive material (except fissionable material) yielded in or made radioactive by exposure to the radiation incident to the processes of producting or utilizing fissionable material.

(2) Distribution. — The Commission is authorized to distribute, with or without charge, by-product materials to applicants seeking such materials for research or development activity, medical therapy, industrial uses, or such other useful applications as may be developed. In distributing such materials, the Commission shall give preference to applicants proposing to use such materials in the conduct of research and development activity or medical therapy. The Commission shall not distribute any by-product materials to any applicant, and shall recall any distributed materials from any applicant, who is not equipped to observe or who fails to observe such safety standards to protect health as may be established by the Commission or who uses such materials in violation of law or regulation of the Commission or in a manner other than as disclosed in the application therefor.

D. General Provisions

(1) The Commission shall not distribute any fissionable or source material to any person for a use which is not under or within the jurisdiction of the United States or to any foreign government.

(2) The Commission shall establish by regulation a procedure by which any person who is dissatisfied with the distribution or refusal to distribute to him, or the recall from him, of any fissionable or by-product materials or with the issuance, refusal, or revocation of a license to him for the transfer or receipt of source materials may obtain a review of such determination by a board of appeal consisting of three members appointed by the Commission. The Commission may in its discretion review and revise any decision of such board of appeal.

MILITARY APPLICATIONS (SEC. 6)

The commission is directed to engage in developmental work on military applications of atomic energy, to produce atomic weapons in such amounts as the President may annually determine, and to deliver manufactured weapons to the armed forces as directed by the President.

All persons are prohibited from producing any device or equipment to utilize fissionable material as a military weapon except when authorized by the commission or when incident to research and developmental activities.

UTILIZATION OF ATOMIC ENERGY (SEC. 7)

The manufacture of equipment or devices utilizing fissionable material or atomic energy, or the utilization of fissionable material or atomic energy with or without such devices is subject to licensing by the commission. However, no such license may be issued until Congress has had a period of ninety days in which to consider a report on the economic and social effects of such a license which the commission must file wi Congress.

INTERNATIONAL ARRANGEMENTS (SEC. 8

Any provisions of this act or any action taken by the co mission under it shall be invalid if they conflict with or a superseded by provisions of any international agreement her after approved by the Senate or the Congress. The commissi is instructed to perform its functions in such a manner as give maximum effect to any such international agreements.

PROPERTY OF THE COMMISSION (SEC. 9)

The commission will take over all the resources of t United States or any Government agencies devoted to or r lated to atomic energy. This includes all atomic weapons, property of the Manhattan Engineer District, and all paten materials, plants and facilities, contracts and information r lating primarily to atomic energy. The commission is autho ized to reimburse States and municipalities for loss of tax incurred through acquisition of property by the commission.

CONTROL OF INFORMATION (SEC. 10)

(A) Policy. — It shall be the policy of the Commissi to control the dissemination of restricted data in such a ma ner as to assure the common defense and security. Consiste with such policy, the Commission shall be guided by the f lowing principles:

(1) That information with respect to the use of atom energy for industrial purposes should be shared with oth nations on a reciprocal basis as soon as the Congress decla by joint resolution that effective and enforceable internatio safeguards against the use of such energy for destructi purposes have been established; and

(2) That the dissemination of scientific and technical formation relating to atomic energy should be permitted a encouraged so as to provide that free inter-change of ide and criticisms which is essential to scientific progress.

(B) Dissemination. — The Commission is authorized a directed to establish such information services, publicatio libraries, and other registers of available information as may deem necessary or desirable to provide for the disse ination of information in accordance with subsection (A).

(C) Restrictions.

(1) The term "restricted data" as used in this sect means all data concerning the manufacture or utilization atomic weapons, the production of fissionable material, the use of fissionable material in the production of pow but shall not include any data which the Commission from ti to time determines may be published without adversely fecting the common defense and security.

(2) Whoever, lawfully or unlawfully, having possession access to, control over, or being entrusted with, any docume writing, sketch, photograph, plan, model, instrument, ap ance, note or information involving or incorporating restric data—

(a) communicates, transmits, or discloses the same any individual or person, or attempts or conspires to do of the foregoing, with intent to injure the United States with intent to secure an advantage to any foreign nation, up conviction thereof, shall be punished by a fine of not m than $20,000 or imprisonment for not more than twenty ye or both;

(b) communicates, transmits, or discloses the same any individual or person, or attempts or conspires to do of the foregoing, with reason to believe such data will utilized to injure the United States or to secure an advanta

any foreign nation, shall, upon conviction, be punished by fine of not more than $10,000 or imprisonment for not more than ten years, or both.

(3) Whoever, with intent to injure the United States or with intent to secure an advantage to any foreign nation, acquires or attempts or conspires to acquire any document, writing, sketch, photograph, plan, model, instrument, appliance, note or information involving or incorporating restricted data shall, upon conviction thereof, be punished by a fine of not more than $20,000 or imprisonment for not more than twenty years, or both.

(4) Whoever, with intent to injure the United States or with intent to secure an advantage to any foreign nation, removes, conceals, tampers with, alters, mutilates, or destroys any document, writing, sketch, photograph, plan, model, instrument, appliance, or note involving or incorporating restricted data and used by any individual or person in connection with the production of fissionable material, or research or development relating to atomic energy, conducted by the United States, or financed in whole or in part by Federal funds, or conducted with the aid of fissionable material, shall be punished by a fine of not more than $20,000 or imprisonment for not more than twenty years or both.

(5) No person shall be prosecuted for any violation under this section unless and until the Attorney General of the United States has been advised and consulted with the Commission with respect to such prosecution.

(6) This section shall not exclude the applicable provisions of any other laws, except that no Government agency shall take any action under such other laws inconsistent with the provisions of this section.

PATENTS AND INVENTIONS (SEC. 11)

No patent will be issued for any discovery or invention useful solely for the production of fissionable materials or the utilization of fissionable materials or atomic energy for military weapons; but the commission will compensate for such invention or discovery. If the invention or discovery is also useful for other than military purposes, a patent will be issued for these purposes only.

Where the invention or discovery relates to the utilization of atomic energy for non-military purposes and a patent is issued the commission may declare it affected with the public interest in which case persons licensed by the commission may use the patent upon payment to the patentee for such use. The commission is authorized to purchase, take or condemn and make compensation for, any invention or device useful solely in the production of fissionable materials for military weapons.

The commission shall designate a compensation board, the duty of which will be to determine reasonable royalty fees and make awards for any invention or discovery useful in the production of fissionable material.

Provisions are set up whereby any persons aggrieved by the action of the board relative to any award or royalty fee may obtain a review of such action in the Court of Appeals for the District of Columbia.

GENERAL AUTHORITY (SEC. 12)

General authority is given the commission to appoint advisory boards, hire and pay employes, use the services and employes of other agencies, buy and own property and erect buildings. Except where specific exemptions are made by the commission, employes are to be appointed with regard to the civil service laws.

The commission is also authorized to make studies and investigations and to hold hearings and summon witnesses for this purpose. It is to establish safety and health regulations for use of fissionable materials.

The President may in advance exempt any specific action of the commission in a particular matter from the provisions of law relating to contracts. Otherwise the laws concerning audits by the comptroller general are in force.

COMPENSATION FOR PRIVATE PROPERTY (SEC. 13)

Compensation for property acquired by the commission in carrying out the provisions of this act is to be determined by the commission. If the amount determined is unsatisfactory, the claimant may sue the United States in the Court of Claims or any District Court and the commission shall pay him 50 per cent of the amount determined pending settlement of the suit. The commission is authorized to exercise rights of eminent domain and condemnation and to purchase and use property prior to approval of its title by the Attorney General.

JOINT CONGRESSIONAL COMMITTEE (SEC. 14)

A Joint Congressional Committee is established to make continuing studies of the activities of the commission, to reconsider bills introduced into Congress on the subject of atomic energy and to make reports to the Senate and the House of Representatives. The committee is to consist of eighteen members, nine appointed by the Speaker of the House and nine by the President of the Senate, with no more than five from each House being members of the same political party.

ENFORCEMENT (SEC. 15)

This section provides penalties for all violations of the act except dissemination of information. In general, three types of violations are specified:

(1) Those committed with intent to injure the United States or secure advantage to a foreign nation. Maximum penalty: $20,000 fine, twenty years imprisonment or both;

(2) Violations of provisions concerning (A) ownership of production facilities, (B) possession and transfer of fissionable material, (C) manufacture of atomic weapons. When committed without intent to injure the United States or give advantage to a foreign nation, the maximum penalty is $10,000 fine, five years imprisonment, or both.

(3) Violations of provisions concerning reports and records, possession and use of atomic materials and health and safety regulations. When committed without intent to injure the United States or give advantage to a foreign nation, the maximum penalty is $5,000 fine, two years imprisonment, or both.

The commission is given authority to apply to the courts for enjoining or restraining orders or for injunctions.

REPORTS (SEC. 16)

The commission is directed to submit to Congress reports and recommendations for additional legislation in January and July of each year. Recommendations for legislation may be made at other times also.

DEFINITIONS (SEC. 17)

This section establishes definitions for the terms "atomic energy," "United States" and "research and development."

APPROPRIATIONS (SEC. 18)

Such sums as may be necessary and appropriate to carry out the purposes and provisions of the Act are authorized. The unexpended funds of the Manhattan Engineer District are transferred to the commission.

SEPARABILITY OF PROVISIONS (SEC. 19)

If any provision of this act, or its application to any person or circumstance is held invalid, the remainder of the Act is not affected.

SHORT TITLE (SEC. 20)

This Act may be cited as the "Atomic Energy Act of 1946."

Hanson Baldwin on Secrecy Provisions

With the secrecy provisions remaining the most controversial subject in domestic legislation on atomic energy—even after the adoption by the committee of a compromise draft of section 10 (see page 4), the following excerpts from an article of a distinguished military analyst appear of great interest to all concerned with the problem.

* * *

"The national control of atomic energy and secrecy, and espionage regulations are contemporary problems that are part of the broader problem of American military policy and that must be solved by a middle-of-the-road approach.

"The problem of secrecy—not only about atomic energy but also about all political-military matters—is even more important to the future of the country than the exact composition of the Atomic Energy Commission.

"The atomic bomb and recent spy cases in Canada and this country have been seized upon as excuses for attempts to tighten greatly—and dangerously—the espionage laws. The scientists rightly fear that too great an emphasis on secrecy not only would tend to increase international friction but would also hamper the development of science, for mutual exchange of basic scientific information is the keystone of much of our material progress."

* * *

Mr. Baldwin then mentions three—as he designates them—scientific "causes celebres"—the action of Gen. Groves in preventing Dr. Condon from going to Russia in the summer of 1945, the request made to the French scientist, Bertram Goldschmidt, either to acquire American, British or Canadian citizenship, or to severe his relations with the Canadian Project, and the refusal to grant a visa to the famous French physicist, F. Joliot. Mr. Baldwin considers the action taken in the first two cases as warranted, but objects to the third.

* * *

"The scientists rightly ask how long this latter sort of thing must go on. If we are to put up intellectual bars around the country, intended to keep all foreign scientists out and all our scientists in, we will create as much of a barrier to international understanding as if we strengthen and build up tariff and cultural barriers. Some secrecy in connection with the atomic bomb and other military projects is essential, but again we must follow the middle ground. . . .

"While we must guard our essential secrets, until the necessity for national strength and national secrecy has been eliminated by international organization, we must be careful that we classify as secret only highly important information, and that our attempts to preserve secrecy do not infringe on democratic processes. The experience of history has been that no military secrets can long be kept; in any case, there is nearly always a definite time limit on their importance.

We can, therefore, in attempting to define secrecy too broadly, grasp at a straw of security at the risk of imperiling those things we are attempting to secure. Today, there is still an aftermath of "over-secrecy" left from the war. . . .

"The worst manifestation so far of the secrecy complex that every now and again assails our democracy was a recommendation made recently to the Senate Atomic Energy Committee. It recommended that the espionage laws be tightened by making it a crime for any official to reveal, without authority, any military "secrets," and for any reporter, radio commentator or publisher to publish or broadcast such information. The definitions, as reported, were broad enough to include under military "secrets" many classifications of news of vital importance to the public and to the nation.

This sweeping attempt to dam the source of news is not new; the same measure has been advocated in much the same form at many previous times by the military or the Department of Justice. There is no doubt that such an act would facilitate the task of convicting spies, but it would also tremendously extend the power of government and might well result in restricting greatly the flow of legitimate news. For the act might apply to all official information of almost any character, and under the cloak of such secrecy the checks and balances that a free press and free public opinion provide might well be eliminated. No such act should be passed or even considered. It is truer than ever, in the atomic age, that 'eternal vigilance is the price of freedom'."

McMAHON BILL STATUS DISCUSSE[D] BY "CHEMICAL AND ENGINEERIN[G] NEWS"

"A few ill-defined powers granted th[e] military because of a real or suppose[d] international crisis may cause us to los[e] rights and liberties of the individual wo[n] during the past seven centuries," say[s] an editorial on atomic energy legislatio[n] in the March 15 "Chemical And Engineer-ing News," organ of the American Chem-ical Society. Discussing what it term[s] "the most important piece of legislatio[n] dealing with the rights of man since th[e] Magna Charta, the Constitution of th[e] United States, and the Bill of Rights, the editorial summarizes the status [of] the McMahon Bill in the Senate Atom[ic] Energy Committee.

Recent statements by President Tru[-]man and Secretary of Commerce Henr[y] Wallace favoring civilian control "hav[e] given new hope to those who favor pos[i-]tive civilian control rather than dire[ct] or implied military supervision of atom[ic] energy activities," says the editorial.

The article concludes, "It should b[e] possible to frame the wording of atom[ic] energy legislation so that top authorit[y] rests with a civilian commission, yet wi[th] adequate provision for a liason with th[e] military until such time as it is possib[le] to turn over international control [to] UNO."

70 THOUSAND LETTERS BACK TH[E] McMAHON BILL

According to the Washington corre[s-]pondent of the New York Times, 70,9[..] letters had poured in, during the last fe[w] weeks of deliberations of the Senate Ato[m-]ic Energy committee, backing the prin[-]ciples of the original McMahon Bill. On[ly] a dozen letters were opposed.

Letters came from individuals, in t[he] form of petitions signed by thousan[ds] and as resolutions voted by organizatio[ns].

Included in the mail were 24,851 lette[rs] opposing the Vandenberg amendment b[e-]fore it was rewritten to the satisfacti[on] of military, legislative and scienti[fic] groups. Also included were 34,725 w[hich] expressed disapproval of the May-Joh[n-]son bill, which had been assailed [as] granting powers far exceeding tho[se] specified in the McMahon bill.

REPORTS OF SENATE COMMITTE[E] TO BE REPUBLISHED ABROAD

A number of foreign countries, it w[as] learned, have become interested in t[he] work of the Senate committee, which h[as] recorded 700,000 words of its non-secr[et] testimony. France has requested, and h[as] received, permission to republish all [of] this open record, and Great Britain h[as] asked for several hundred copies of t[he] texts.

ome Political Implications of the State Dep't Report

. . . *Edward A. Shils*

The Lilienthal Committee dealing with olitical problem of the utmost delicacy striven to reduce the political element the Report to a minimum and to con- itself as much as possible to the tech- al aspects of the problem. Naturally has been impossible to avoid political ies in the treatment of a subject at the y heart of which lies the alternative- intenance or parital renunciation of na- al sovereignty. It is the aim of the owing comments to elucidate some of political decisions which will have to associated with the ADA if the scheme to be effective in the preservation of ce, and to examine whether alternative isions would be compatible with the eme.

Should Sovereign States Possess Bombs?

lthough it is not clear whether the neson Report intends that the ADA intain a stockpile of atomic bombs, it airly explicit on the proposition that individual state shall possess atomic bs—within the framework of the eement and once the control plan is ull operation. Inasmuch as a group of most distinguished authorities includ- Professors Bernard Brodie and Wil- n T. R. Fox of the Yale Institute of ernational Studies have proposed the versal possession by sovereign states tockpiles of atomic bombs large enough nflict very severe damage on any atomic b aggressor, it is perhaps worthwhile examine the matter farther. The argu- t of the Yale group is that complete nic bomb disarmament would give any ndestine producer of the bomb a great antage in international relations by bling it to impose its will on other ers which would suffer for having ered strictly to the atomic disarma- t agreement. Due to the speed with ch atomic bomb destruction can be summated on a grand scale and due impossibility of closing the gap be- en prepared attacker and unprepared im in the way in which the less war- states did during 1940-1943, success- evasion would be almost a sure step dominance. And awareness of this fact ld give a tremendous premium to all es; even those which otherwise would e adhered with utmost strictness to the eement would be impelled to under- e clandestine production.

gainst this position, what can the onents of the Acheson report main- ? In the first place, the psychological sequences would be pernicious. The uni- al possession of atomic bombs would te too high a level of anxiety in inter- onal relations, and cause instability judgment in diplomatic negotiations; anxiety would interfere with the detachment and clarity of mind which diplomats need for success in the conduct of their business. Fear and suspicion of everyone as a potentially murderous aggressor would be intensified—since the retaliatory stockpile could serve only as an instrument of revenge but not as a defense. Minor international frictions already so overstressed by the press would become magnified into major crises in which the total life or total death of the powers involved were at stake. This in turn would lead not to the avoidance of "incidents" but to their multiplication since fearful men are hypersensitive to every move which is allegeable as a threat to their status, power or safety. In the type of anxiety-ridden situation which might result, statesmen might commit even the ultimate irrationality of believing that one can end the crisis by an atomic bomb blitzkrieg against the "threatening" opponent. The anxiety and therewith the irrationality of the populace would probably be heightened even more, and in democratic countries this might have an extremely unsettling influence on the conduct of foreign affairs.

Second, the state of mind which the Yale scheme would create would increase the probability of an armaments race in atomic bombs. Since the Yale group assumes that inspection is not likely to be successful—otherwise, why build up a system based on the expectation of its failure—it is incumbent on it to allow each nation its own facilities for producing additional bombs in a fairly short time in order to allow it to cope with the possible evasion of the original agreement to maintain only a limited stockpile.

(It should be acknowledged that the Acheson Report rests to a greater extent on the omniscience of its staff or the inspection of "safe" installation than the tone of the Report implies. But this is only a quantitative and qualitative personnel problem and is not difficult to solve.)

If each state did not have its own facilities, it could not feel secure since, under the prevailing tensions, there would not be sufficient confidence in the equitable distribution or use of bombs by an international organization. From this stage to the universal atomic armaments race is surely not a long step.

Third, the Yale proposals not only assume the inefficacy of inspection, they actually tend to create situations which condemn it to failure.

The Acheson Report emphasizes that inspection pure and simple would aggravate suspicions but that inspection-cum-research-cum-operation will not do so. This may be arguable but it is not arguable that the latter type of inspection-control system could not work where there is a high level of mutual suspicion and fear. A country which feels threatened by the existence of stockpiles of bombs in the hands of neighbors is likely to resent the presence of members of those other states in the atomic energy laboratories and plants within its own territory, acting as a check on its bomb production at a time when the other states might be diverting materials or actually producing bombs. The mutual solidarity of scientists, engineers and other technical personnel which is indispensable for the success of the Acheson scheme will not develop under such conditions.

Fourth, the universal possession of a permitted stockpile of atomic bombs along the lines of the Yale scheme modifies the present balance of power and thus reduces the acceptability of control by the major powers. The Yale group rightly says that any proposal for atomic bomb control will have a better chance of acceptance by the major powers if it leaves the present balance of power in the world unchanged. A peculiar characteristic of the atomic bomb on international relations is that it tends to reduce the margin between previously strong and weak powers if both possess bombs.

Since the Yale proposals are made with the intention of being realistic, it is therefore in order to ask whether the Soviet Union with all its suspicion of the outside world would prefer a system in which a coalition of hostile powers had considerably more bombs than it had—under the Yale scheme, the total number of permitted bombs would not equal the number required to knock out a major power and no single power alone would have more than a minority of the the total number of bombs—to a system in which, thanks to the presence of its own trusted nationals in laboratories and factories everywhere in the world, it could know that the other powers are also without bombs or the apparatus for making them more quickly than the Soviet Union itself could make them. The latter would most probably be chosen, firstly, because it offers more security and second because it promises to maintain the present Soviet position in the world—in which it is as strong as any coalition of powers as long as pre-atomic bomb armaments and political means are used—better than a scheme which would render the Soviet Union inferior in strength to a hostile coalition—which it fears more than anything else in the world. Thus

the assumption of "bomblessness" which underlies the Acheson Report is not only more idealistic, it is also more realistic than the proposals of the Yale group and it is more likely to obtain the assent of the Soviet Union.

SHOULD THE ADA HAVE A BOMB STOCKPILE?

The Acheson Report leaves open the question as to whether the ADA will possess a stockpile of bombs. Perhaps the authors intended that the matter be decided by the Security Council. But whatever their unexpressed desires on the subject, the chances for the acceptance of the ADA scheme and its successful operation will be best furthered by a decision which prohibits atomic bombs anywhere. If the Security Council or the ADA possess a stockpile of atomic bombs while no other state has them, the incentive to evasion will exist as long as solidarity within the Security Council is as low as it is at present among the major powers and as long therefore as one of them feels it has grounds for distrusting the others. This situation would be much like the present one in which the Anglo-American bloc shares the atomic bomb and the Soviet Union has none in the sense that the Soviet Union would always be fearful that the ADA or Security Council stockpile would be used against it in a severe crisis in which the Security Council might disintegrate. Nor would it be satisfactory for the ADA or Security Council stockpile to be distributed within the various national territories—this would be tantamount to the universal distribution of the atomic bomb dealt with above and would provide the same incentives to evasion, the same stimuli to anxiety and irrationality. The possibility of any of the member states seizing and discharging the bombs stored within its territory would be too great for the sense of security of the other states.

Thus, the ends set forth in the Acheson Report will be achieved best if the proposal which incorporates them is associated with a prohibition of atomic bombs anywhere, either in the possession of the individual sovereign states or in the stockpile of an organ of United Nations, be that stockpile either concentrated in one place or dispersed in a variety of places throughout the world.

II. ADA and the Security Council

The Acheson Report is silent on the relationship of the ADA to the Security Council. This may be due either to the intention of the authors to avoid the intricate and politically hypersensitive problems which any discussion of the Security Council necessarily raises but it might also be due to the desire of the authors to make the ADA independent of the Security Council. The use of the term "Authority" in the title of the ADA and Mr. Lilienthal's important role as Chairman of the Board, permits an inference that the authors of the Report envisaged a fairly autonomous status for the ADA equivalent to that enjoyed by public corporations in contemporary society.

There would be obvious advantages in an autonomous status of the ADA vis-a-vis the Security Council. For one thing, the decisions of the ADA in the allocation of "safe" materials would not be subject to the exercise of the veto power. Thus decisions could be made in terms of human welfare rather than military strategy. Independence from the Security Council would reduce the emphasis on military aspects of atomic energy and would nurture an attitude more sympathetic to the promotion of the peaceful aspects of atomic energy. It is conceivable also that due to the great importance of the ADA in the eyes of the world, its successful operation as an autonomous body would contribute more to the prestige of the United Nations than would be the case if it were subordinate to the Security Council. The Security Council is not likely, in the near future within which the ADA must come into existence, to grow greatly in prestige because if it continues to be the arena of conflict between the major powers, successful reputation-building compromises are not likely to be achieved by the public debates which is one of the main characteristics of the Security Council. Nor if it is the arena in which large powers control small powers, will the reputation of the Security Council as a guardian of peace be enhanced. Association of the ADA with the Security Council will thus involve the ADA in the difficulties of the Security Council and hamper its work by exacerbating the suspicions which will probably also exist among the members of the ADA until it has proved itself to be a genuinely reliable organization for all the parties concerned. On the other hand, if the ADA succeeds, in its autonomous role, in acquiring a large amount of prestige, that will in turn be reflected on to the United Nations Organization and thereby aid it in the fulfillment of its great responsibilities.

Nonetheless, even if the autonomy of the ADA within the U.N were desirable, it does not appear to be an immediate likelihood. The Atomic Energy Commission of the United Nations has in fact already been charged with reporting to the Security Council, by the resolution of of the General Assembly on the 24th of January, 1946. The Commission itself consists of representatives of states which are members of the Security Council plus Canada, and this increases the likelihood that the Security Council will maintain some type of control over the ADA. In
addition to this, the ADA decisions wil
in fact be strategic decisions, not onl
as regards the geographical location o
the laboratories in which military re
search will be conducted and of the in
stallations using undenatured fissionabl
materials, but as regards the geographica
distribution of "safe" materials as wel
Even though the Acheson Report prefer
to treat the use of "safe" materials a
something relatively uncontaminated wit
military significance, the fact that de-de
naturing can occur and that accordingl
a nation with a highly disproportionat
share of "safe" materials would enjoy
large lead over other powers, if it de
cided to abrogate the international agre
ment and to use its "safe" materials t
make them "unsafe" is a fact of consi
erable military relevance. It is therefor
not easily imaginable that such crucia
decisions affecting the ultimate safety o
individual states will be entrusted to
body in which there is no veto powe
Finally, the military research and ex
perimental activities which the Acheso
Report recommends should be monopo
lized by the ADA, are without doub
proper to the jurisdiction of the Militar
Staff section of the Security Council ar
not even the most ingenious argumen
can change this situation. One solutic
to this difficulty might however be th
formation of a special Department of Mil
tary Research and Experiments whic
although under the jurisdiction of th
ADA, would have a liaison committe
with the Military Staff, such as is no
proposed in the newly revised McMaho
Bill. This type of acknowledgement o
the legitimate claims of the Militar
Staff of the Security Council would pe
haps be helpful in reducing the wish
of the Security Council to dominate th
ADA in its entirety.

Finally, there should be mentioned o
of the most important of all consideratio
which should make us willing to acce
the dominance of the Security Coun
over the ADA despite certain benefi
which might result from their separatic
The Soviet Union has, through its of
cial organs, expressed itself on many c
casions as insistent on the retention
the veto power. It is the issue on whi
the Soviet Union is least likely to yie
The hope which the Acheson Repo
brought into the world will remain hop
ful only if it is rapidly translated in
reality—delay will certainly reduce
acceptability since the passage of ti
will reduce the value of the safeguar
which it proposes. Hence in view of t
adamancy of the Soviet Union on the ve
power and the urgency of rapid acti
on the Acheson Report, it will, all in a
be undesirable to demand uncomprom
ingly the independence of the ADA fr
the Security Council.

Administrative Structure

ust as the Acheson Report avoids some the political problems which must be fronted and solved if International trol is to be established successfully, also avoids the systematic treatment administrative problems. It is in fact nt on the internal organization of the A though it must be acknowledged that silence does no damage to the Re-, since the elaboration of organiza-al details can be delayed. The spe- character of the inspection program mbrated by the Report makes it worth le to explore at least one of the ad-istrative problems, namely, personnel inistration.

he almost complete identification of ection and operation activities means there will be no major Inspection artment in the ADA. The fact that inspection of "safe" laboratories and ts will presumably be carried on by bers of the ADA staff who are en-ed as scientists or engineers in the arch and industrial operations will ously render superfluous a special rtment to administer inspection. It ather more likely that the licensing "safe materials"—allocating func-s will be in a single department which assign scientists or engineers to work stipulated time periods at the labora-es or plants which have been licensed granted "safe" materials. (Another rtment will probably be concerned the operation of "unsafe" scientific industrial installations. No inspection be necessary at these enterprises in-r as the personnel are trustworthy). he Mining Department the personnel inistration tasks will be the same, ely: assignment of carefully selected viduals of diverse nationalities to icular mines which are owned or ed by the ADC.

nce the scientist and engineer in-tors will have to write reports on observations, a Reports Department be necessary for their collation and ysis.

here will however have to be a spe-zed Inspection Branch in the Mining artment, for the conduct of surveys ines newly opened in different parts he world to determine uranium and ium content of the output of those s. The aerial survey function which be necessary for the discovery of mines will likewise fall outside the y operational or, as the Report calls , "positive activities" of the Depart-t and will undoubtedly have to have ecial branch devoted to its adminis-on. It should be emphasized that of the inspection activities of the will be exclusively inspectional, e.g. search for clandestine mining operations, the sampling of the output of non-uranium mines, etc.

This presumed administrative structure will be seen to differ from the administrative structure outlined in Professor Wright's Draft Convention (**Bulletin**, Vol. I, No. 8) which provides for an Inspection Commission separate from the Administrative Commission both of which are subordinate in policy matters to the Security Council, which in its turn acts on the advice of the Atomic Energy Commission. It seems safe to infer that the international administrative problems of the ADA will be simpler than those raised in the Chicago Draft Convention because the licensing, materials-granting and inspectional activities will be carried on through the same department. The internal differentiation of Prof. Wright's scheme would be reduced if it were to provide for ownership and operation of all uranium and thorium mines, and for the operation by an international body of power installations, if and when they are established.

PERSONNEL SELECTION

The major administrative problems of the ADA will, however, rest not on those who are charged with drawing up its organization chart, but on those whose task it will be to devise the proper personnel policies on which the success of the entire enterprise will depend.

Moral trustworthiness, intellectual alertness and ingenuity, and facility in social relations will be qualities without which the scheme will be doomed to failure. Inadequacies in any of these catagories and in others will both reduce confidence in the plan and stimulate and allow evasion. Hence in the last analysis if the proposals in the Report are accepted, the question of successful functioning comes to whether the ADA can abstract and select the kind of people who can do the job.

Under ordinary conditions, when a scientist is to be chosen for a particular scientific task, the criteria by which he is to be chosen are fairly specifiable and applicable; if an engineer is required, the measures of an engineer's ability are also fairly easy to specify and to apply, and the prospects of getting the type of man described are usually quite good. Likewise if one wishes to employ policemen or a secret agent, the qualities which are necessary though more difficult to define verbally and less easy to check, are nonetheless capable of determination. But if one wishes simultaneously to employ a scientist with the alertness of a high-grade secret service agent who will also have the capacities of an ambassador, of a foreign correspondent, and of a professional traveller who is capable of acquiring the main elements of a foreign culture in a short time, and who can come to feel at home in a strange cultural surroundings without insuperable difficulties, then the task begins to approximate the order of magnitude involved in the selection of the kind of personnel required by the ADA.

Fortunately, recent developments in the United States and Great Britain in the application of modern dynamic personality theory to personnel selection provide grounds for optimism. During the recent war, the Office of Strategic Services employed Prof. Henry Murray of Harvard University, who is one of the most outstanding specialists in the study of personality, to develop techniques of selection which would help that organization to obtain men who could be used as undercover intelligence agents, and saboteurs behind enemy lines. (Professor Murray's activities are popularly described in **Fortune Magazine** of March 1946). Prior to Professor Murray's work, the British War Office had begun to apply the results of modern personality theory and research to similar problems and on a universal and highly successful scale to the selection of army officers; more recently the same group who developed the War Office Selection Boards have begun to adapt their techniques to the selection of the Higher Civil Service of Great Britain. These techniques are capable of disclosing important personality traits which the ordinary psychological tests previously used in personnel selection could not perceive. In the research at present being carried on by the Tavistock Group of psychologists and sociologists in London, these selective techniques are being further developed to the point where they can be used for the most diverse professions. The Personnel Department of the ADA will undoubtedly have to adopt these techniques since the success of the plan, to say nothing of the whole future of mankind, will rest on the intelligence, alertness, trustworthiness and social adaptability of the scientist- and engineer-inspectors. However, not only will special techniques of selecting already available personnel be necessary; it will be imperative to train new persons who have met the preliminary personality and intellectual qualifications and who will thereupon be trained in the languages and cultures of the countries to which they will be assigned and in the special skills necessary for the various roles which have to be performed. It is therefore likely that a Staff College, conducted by the ADA or preferably a special Faculty of an International University, conducted by UNESCO, will be necessary for the formation of this unique kind of International Civil Service.

(Continued on Page 19)

Repercussions of the State Dep't Report

Proposed Senate Resolution

A resolution urging immediate negotiations within the United Nations to give effect to the State Department report was introduced by Senator Hugh B. Mitchell, Democrat, of Washington. His fellow sponsors were Senators Harley M. Kilgore, Democrat, of West Virginia; Wayne L. Morse, Republican, of Oregon, and J. William Fullbright, Democrat, of Arkansas.

The resolution was referred for consideration to the Senate Atomic Committee, whose chairman, Senator Brien McMahon, Democrat, of Connecticut, was pleased by its aims.

Text of Resolution

Whereas, the secretary of State's Committee on Atomic Energy has issued a report outlining a feasible method for the control of the production of atomic energy by all nations;

Whereas this recommended method does not entail the surrender of any atomic secrets until effective international control protecting all humanity is assured;

Whereas, available evidence indicates that prevention of atomic warfare is the only effective defense against the destructive force of the atomic bomb;

Whereas no nation can be secure when the scientists and industrialists of all nations are free to discover and make atomic bombs;

Whereas, it is necessary to end all competition between nations to make bigger and more destructive atomic bombs; therefore be it

Resolved, that it is the sense of the Senate that the security of the United States and of all nations requires prompt action on an international basis along the lines outlined in the State Department publication entitled, "A Report on the International Control of Atomic Energy," and that negotiations within the United Nations be undertaken immediately upon the basis of the report to the end that its provisions be adopted and a realistic hope of peace be substituted for the present universal fear of mass annihilation through atomic war.

The resolution will serve, in two weeks, as a point of focus for a new series of hearings devoted to the problem of how to cope with the international aspects of control.

Senator Fulbright (Arkansas) supported this resolution in an interview which he gave to the press on April 13:

Urging that the State Department move at once to put into effect its long-term plan for world safeguards against misuse of atomic power, Fulbright said that such action might stabilize U. S. relations with Russia.

He said the plan represents "a real chance" for this nation to show world leadership. The plan is "a good offer to the world."

If such an offer were put forward by this country and rejected by Russia, Fulbright said, it would clearly indicate that the U.S.S.R.'s long-run intentions were not peaceful.

Comments by Members of the State Department Committee

The St. Louis Post-Dispatch has performed a great public service by reprinting the State Department Report in its issue on April 7. In addition, it has solicited comments on the report from the members of the Acheson Committee, the Lilienthal board and from prominent scientists. We print below some quotations from this symposium.

Dean Acheson, Under Secretary of State: "The work of the distinguished Board of Consultants who prepared this report provides, in my opinion, the most constructive analysis that has appeared and a sound and hopeful approach to a solution.

"But even beyond these considerations the report has a deeper significance as a demonstration of the process by which we as a nation can come to grips with this problem.

"The board's report brings to bear upon the problem a painstaking examination of the facts, a patient consideration of alternatives, and a constructive effort to develop proposals in the light of the facts. Not until this process has been widely repeated by the public at large will it be possible to understand the issues and formulate by democratic action a wise national policy and the detailed plans necessary to carry it out."

Dr. Vannevar Bush, president, Carnegie Institution; director, Office of Scientific Research and Development: "The report of the Board of Consultants on the International Control of Atomic Energy is the hard-thought product of extraordinarily able and realistic minds. It makes the best and most encouraging proposals I have seen for dealing with the novel problem posed by our ability to utilize the power of nuclear fission.

"Undoubtedly improvements in various phases of the proposals of the report can be accomplished through further thought of the same high quality. Sincere reasoned discussion of the problem is the duty of every American, and the consultants have made such discussion feasible. For they have laid down a positive, practical, common-sense basis for general consideration and the formation of national policy."

John J. McCloy, former Assistant Secr tary of War: "In my judgment, the r port is distinguished for its helpful affir ative and practical approach to the sol tion of the problem of the control and d velopment of nuclear energy. The repo letter of transmittal and Secretary Byrne foreword stress the fact which I thi all readers should constantly bear mind, namely, that the report, in su stance, only suggests a policy; it not yet in the form of an articulated detailed plan. Before it reaches this sta further work by other groups will be n cessary, but we have felt that the pla supplemented by such work, was w capable of this expansion."

Maj. Gen. Leslie R. Groves, executi director, Manhattan Engineer Distri "We are at the threshold of a tremendo venture. Recognizing fully that she force is not a substitute for moral prin ples, we must nevertheless insure a sa period for the gradual evolution of sou national and international policies throug out the world. The world needs an inte val during which nations can learn rule and be ruled by intelligence, mor and law; during which all nations w co-operate to create the means by whi all peoples may live without fear of ing destroyed by wars.

Dr. James Bryant Conant, preside Harvard University: "As a member Dean Acheson's committee I have alrea recommended the plan to the Secreta of State for his consideration. As a p vate citizen may I add my enthusiastic dorsement of the proposal developed the panel of consultants headed by Da E. Lilienthal.

"I believe this plan could be put i effect as suggested by the panel and the letter of transmittal in such a w as to insure the safeguards necessa to protect this government and the tire world from the misuse of ato power.

"In the discussion, I trust attent will be focused on the necessity for veloping a scheme for removing the ato bomb as a weapon for surprise atta If the scheme contemplated can fina be put in full operation no nation wo have to fear that without warning cities might be devastated by ato bombs. Furthermore, mere operation the international agency proposed wo be a long step forward in strenghthen international co-operation. Once this g of controlling atomic energy had b reached, it should not be too difficult provide other ways of strengthening United Nations organization and elimin ing war among great nations."

Repercussions of the State Dep't Report

Opinions of Lilienthal Board Members

David E. Lilienthal, director of the ennessee Valley Authority said at the ational Press Club in Washington on pril 10, that this country should start mediately to negotiate for a plan of ernational control to end the present omic armament race." He said the oblem would become infinitely greater action was delayed until other nations d atomic plants and stock piles of sionable material.

n answer to a question he said no plan uld succeed without Russian coopera- n, and that atomic plants would have be built in Russia as well as elsewhere obtain an atomic balance of power.

Chester I. Barnard, president of the w Jersey Bell Telephone Co., stated in St. Louis Post-Dispatch: "The plan, adopted, would have a great chance of cessfully accomplishing its purposes. ese purpose are to stop and prevent a e for atomic energy armament, to put nations of the world on an equal basis protection against the surprise use of mic energy in war and to insure the cetime benefits of atomic energy for people. The plan does not eliminate r nor would it eliminate the use of mic energy weapons in war, but it uld prevent its surprise use.

Many people will hope and ask for a n which can be guaranteed to serve se purposes or even larger purposes. s is impossible, I think, not only with pect to this plan but to any other than uld be devised. That being the case, may well ask in this as we do in more nary affairs: Why embark on a course lving any risks against which there ly can be no genuine insurance? My wer is that the risks of disaster in not pting this or any better plan that can devised are very much greater than risks that will be incurred by adopt- it. I do not think the people generally realize how great these risks are.

t is now well known, of course, that e is little or no defense against the ruction of our cities by atomic bombs. at is not sufficiently realized is that use there is no good military defense, best protection would require a radical rangement in our industrial plants, ur way of living and in the geographi- distribution of our population. I do thing it likely that this could be accom- hed under a democratic government, it would involve the most serious in- erence with the liberties of all of us would also, I think, require us to accept for many years a dractically reduced standard or living.

Dr. Charles Allen Thomas, vice-president and technical director, Monsanto Chemical Co., St. Louis, said according to the St. Louis Post-Dispatch: "It is of importance that thinking American citizens read this report, study the contents carefully and make up their own minds regarding the feasibility of the proposal.

"One major point in the report will bear repetition—unless a plan such as this is adopted, we may be faced with a constant war of nerves. We are and will be disturbed by rumors of sensational developments in other lands. Without a positive and practical plan for international control of atomic energy, it is quite conceivable that some nation might announce that they have a large stock of extremely efficient atomic bombs. True or not, such a statement would certainly have a most disquieting effect on the other nations of the world. It might lead in our own country to a condition of natural neurosis which would cause fundamental changes in many of the institutions which form the backbone of our democracy.

"If and when such a plan is put into effect and each nation through the Atomic Development Authority, knows what the other is doing on atomic energy developments, the use of atomic weapons as an insidious threat should be eliminated."

Denaturing Fissionable Materials

A STATEMENT BY EXPERTS.

The following statement was prepared by a Committee of Manhattan Project Scientists appointed by Gen. Groves:

"The possibility of denaturing atomic explosives has been brought to public attention in a recent report released by the State Department on the International Control of Atomic Energy. Because, for security reasons, the technical facts could not be made public, there has been some public misunderstanding of what denaturing is and of the degree of safety that it could afford. We have thought it desirable to add a few comments on these points.

The report released by the State Department proposes that all dangerous activities in the field of atomic energy be carried out by an international authority, and that operations which by the nature of the plant, the materials, the ease of inspection and control are safe, be licensed for private or national exploitation.

The report points out that the possibility of denaturing explosive materials so that they "do not readily lend themselves to the making of atomic explosives" may contribute to the range of licenseable activity and the overall flexibility of the proposed controls. The report does not contend nor is it in fact true that a system of control based solely on denaturing could provide adequate safety.

As the report states, all atomic explosives are based on the raw materials, uranium and thorium. In every case the usefulness of the material as an atomic explosive depends to some extent on different properties than those which determine its usefulness for peacetime applications. The existence of these diflerences makes denaturing possible. In every case denaturing is accomplished by adding to the explosive an isotope which has the same chemical properties. These isotopes cannot be separated by ordinary chemical means. The separation requires plants of the same general type as our plants at Oak Ridge, though not of the same magnitude. The construction of such plants and the use of such plants to process enough material for a significant number of atomic bombs would probably require not less than one nor more than three years. Even if such plants are in existence and ready to operate some months must elapse before bomb production is significant. But unless there is reasonable assurance that such plants do not exist it would be unwise to rely on denaturing to insure an interval of as much as a year.

For the various atomic explosives the denaturant has a different effect on the explosive properties of the materials. In some cases denaturing will not completely preclude the effectiveness by a large factor. The effect of the denaturing is also different in the peaceful applications of the material. Further technical information will be required, as will also a much more complete experience of the peacetime uses of atomic energy and its economics, before precise estimates of the value of denaturing can be formulated. But it seems to us most probable that, within the framework of the proposals advanced in the State Department report, denaturing will play a helpful part."

In conclusion, the experts support the assertion of the report that there is no forseeable method of releasing atomic energy without uranium as raw material, although with uranium, thorium can also be used.

The statement was signed by:

L. W. Alvarez, R. F. Bacher, M. Benedict, H. A. Bethe, A. H. Compton, Farrington Daniels, J. R. Oppenheimer, J. R. Ruhoff, G. T. Seaborg, S. H. Spedding, C. A. Thomas, W. H. Zinn.

Scientists Comment on State Dep't Report

Statement by the Federation of American Scientists

The Administrative Committee of the Federation of American Scientists at Washington issued on April 11 a statement which reads in part as follows:

American scientists are overwhelmingly in favor of the principles of the "Acheson Report", judging from a survey of member associations of the Federation of American Scientists, including "Atomic Scientists" at Oak Ridge, Los Alamos, New York, the Chicago Metallurgical Laboratory, and other research centers from Boston to San Francisco.

Ever since they realized their research would be successful in releasing the energy contained in the atom, physicists have recognized that the problem of controlling and developing this energy wisely for the benefit of all mankind was a world problem.

Scientists are enthusiastic about the Acheson report because in its proposals for a world Atomic Development Authority inspection would go hand in hand almost automatically with development of peaceful uses.

The Acheson Report proposals on the other hand are positive, affirmative, and constructive. They seem to be based on the belief that hope can be as compelling a motive as fear.

We may say that so far as atomic energy is concerned, fear of its power is the beginning of **wisdom**. But only hope and faith in man's future can be the beginning of **action**.

Many of the scientists queried, including outstanding scientists who worked on the atomic bomb, said that they personally would be glad to work for an organization such as Atomic Development Authority. "The world's sympathy and its resources are now mobilized in such organizations as UNRRA," said one. "That is essentially a work of repairing war's destruction. Never in man's history has he mobilized worldwide resources and worldwide intelligence in a particular field of knowledge as is suggested by the Acheson report. It is a revolutionary idea for a revolutionary age. I can not help but think that if it were set in operation it would bring such gratifying results that it would make easier all other steps proposed towards international cooperation."

Comments by Scientists

Dr. A. H. Compton, chancellor, Washington University; adviser on many aspects of the atomic bomb development: "The proposal for international management of the atomic energy presents a sound and constructive basis for solving this difficult problem. In fact, it is the only adequate basis that has yet come to my attention.

"It is not easy, because it involves international control of an important industry, which means an international working agreement on a task of hitherto unparalleled importance.

"It is hopeful, because it reserves an important place in atomic development for private and national initiative, while, at the same time, it gives to United Nations organizations the major responsibility for handling the dangerous aspects of atomic energy.

"An international authority which will carry on throughout the world the 'dangerous' aspects of atomic power development and research, together with its power to carry on the limited amount of inspection necessary to keep safe the 'safe' aspects of this development, gives to the United Nations organization a definite and necessary task, worthy of its growing strength, and for which no other agency is appropriate. I am pleased to note that, step by step, it appears possible for the U.N. to take on complete responsibility for this development, including whatever military policing may be required.

"Until this organization is functioning strongly, I see no alternative but to keep our own atomic weapons intact and ready for use. In the long run, however, our safety cannot lie in our own atomic strength. Before many years, nothing short of a world police capable of preventing outbreak of war can serve as an adequate protector."

Dr. Karl T. Compton, president, Massachusetts Institute of Technology: "It is highly important that every possibility for international co-operation and control of atomic energy be explored. Undoubtedly every plan will have some unpleasant features, but the essential question is: Are there any better alternatives? Some plan must be found and no plan should be finally rejected except on the basis of a better alternative having been found.

"Insofar as I have learned from newspaper reports about the plan proposed by the State Department, it seems to be the only thoroughly considered proposal which has yet been made and to present an effective compromise between the presently impractical suggestion of a world state, on the one hand, and the terrifying prospect of doing nothing, on the other hand."

Dr. F. R. Moulton, secretary, American Association for the Advancement of Science: "In my opinion the report on the international control of atomic energy will be regarded as a great historic document distinguished alike for its scientific excellence and its statesmanship."

Dr. H. C. Urey's endorsement of the report was reprinted in the last issue of the Bulletin.

AMERICAN CHEMICAL SOCIETY RECOMMENDS THE REPORT

The council and board of directors of the American Chemical Society, representing 47,000 American chemists, issued a statement on April 9, commending the report of the State Department's Committee on the International Control of Atomic Energy as "warranting the best thought of the United States."

"The American Chemical Society," the statement says, "is cognizant of the agreed declaration of Nov. 15, 1945, issued by the President of the United States and the Prime Ministers of the United Kingdom and Canada, calling for international control of atomic energy when proper means and safeguards have been established for the over-all protection of the peoples of the world.

"We concur that once a workable plan has been evolved and genuinely embraced by the nations, therein will lie our greatest promise of bringing about international understanding and comity of nations, thus permitting the benefits of this new science to revert to the betterment of mankind. When such a plan can be put into effect, there will be no necessity for 'secrets' and again science will be free and unfettered.

"We are aware of some of the proposals for international control but our council and board feel it is too early to comment on some of them. However, we unqualifiedly feel that the report on the international control of atomic energy issued under date of March 16 by the State Department warrants the best thought of the United States as we move toward a broad policy."

INTERCOLLEGIATE CONFERENCE URGES UN ATOMIC RULE

Three hundred delegates from thirty-five Pennsylvania colleges approved atomic energy control recommendations after heated debate, at a recent conference in Harrisburg, stating that nuclear power should be controlled exclusively by a United Nations regulation group.

ispersal of Cities and Industries

. . . . *J. Marshak, E. Teller and L. R. Klein*

n an atomic war, congested cities would ome deathtraps. A country like the ted States with a large part of its ulation concentrated in big cities along eastern seaboard is particularly vul- able to the devastating impact of nic bombs. Would it help to disperse cities and industries, to spread homes plants over the countryside, or even uild underground accommodations?

f course, such dispersal is costly and ns great changes in our way of life. vever, two arguments can be advanced s favor. First, it is a form of defense. ond, it helps to maintain the peace.

the case of sudden attack, dispersal ities may mean the difference between rmination of one third of our popula- and the death of only a few million le. Only! This shows both the im- ection and the necessity of this step ard defense.

ispersed populations and industries e war less probable and less sudden use the aggressor's gain from a sur- attack is reduced. Suppose, for nple, that a dispute arises between signers of an international agreement. tence of big cities may then present mpting target to an aggressor who even believe that he is acting in defense. A surprise attack cannot im- iately knock out a country with a dis- ed population if an international ement had insured the world against existence of large stockpiles of atomic bs. Thus dispersal of cities may help naintain the peace by affording a thing spell during which conciliation be attempted.

has been argued that an effort to- ds dispersal or even a serious discus- of the subject in one country is pro- tive to the rest of the world. If this ment were true, it would also apply ll other purely defensive measures as the construction of anti-aircraft eries. If a country fulfills its inter- nal obligation not to make atomic s and other major destructive weap- then the dispersal of cities cannot onceived as a step in an armament In addition, serious discussion of dispersal will make this and other ns aware of the magnitude of the s involved and thus more willing to actively for world cooperation.

be sure, neither rebuilding our cities international treaties can provide than a temporary measure of safety. ing that we can now plan as a de- for the next generation is likely satisfactory; that is, nothing but l-union.

VARIABLES OF A BOMB ATTACK

Before we outline a specific plan of relocating the population, it is worth while to define more clearly the factors affecting the amount of destruction. Of these factors, three are controlled by the attacker: the number of bombs, the destructive power of a single bomb (measured by the size of the destroyed area), and the accuracy of aim. Since each of these factors involves expense, the attacker will not be able to increase all three factors without limit. The fourth factor, which is the distribution of the population, is the only one which can be controlled by the defender. The extent to which dispersal can be achieved is limited by the existing inhabitable area of the country and, of course, by the economic cost which we shall discuss later.

It is easily seen that the area endangered by one bomb is greater the larger the radius of destruction. But the endangered area is also larger the less accurate is the enemy's aim. Therefore, on the one hand, it becomes less worth while to disperse population as the destruction radius of bombs increases, while on the other hand, the increasing accuracy of aim makes dispersal more and more advantageous as a defense measure.

In the long run, no great error in aiming accuracy can be assumed on the part of the enemy. Either by developing methods of internal sabotage or by inventing expensive aiming instruments it may even prove possible to detonate bombs with pin-point accuracy. Let us assume provisionally this extreme accuracy. This assumption will enable us to discuss with greater clarity the advantages of the dispersal of cities, and its limitations.

The ideal situation would be to have our population dispersed evenly over the 3 million square miles of our inhabitable area. In this case, each of our 40 million or so dwelling units (including some shops) would be placed in a separate square of 3 million square miles ÷ 40 million = 1/13 square mile approximately; there would be a distance of about ¼ mile between any two neighbors. Such complete dispersal is, however, not feasible. It would be extremely costly, especially because of the required water, gas and transportation facilities. Also such a scheme would profoundly change our present gregarious way of life—more, it can be assumed, than people would be willing to accept.

But is such extreme dispersal necessary? A bomb of the type dropped on Hiroshima would devastate an area almost a hundred times greater than the plot belonging to one house under a complete dispersal arrangement. It would, therefore, destroy about a hundred houses. If clusters containing a hundred houses each were built, a bomb would not do much more damage than if the houses were dispersed and spaced ¼ of a mile apart.

CLUSTER AND LINEAR CITIES

A considerable part of the protection provided by complete dispersal can thus be obtained even if people live in clusters, provided these are properly spaced. As an approximate rule one might propose that the distance between any two towns should just exceed the diameter of the destruction area of the bomb. Bombs of the Hiroshima type would call for dispersal into evenly spaced towns set, say, 3 miles apart. But as the destruction radius will probably become larger, larger distances between towns, and consequently, since the country's total area is limited, larger towns will be permissible. Let us assume, for example, that a single bomb could destroy an area that a thousand to ten thousand houses would occupy in case of complete dispersal. Then it will be reasonable to have towns of a thousand to ten thousand houses each. The difference in the degree of social and cultural upheaval implied in the cluster scheme as compared to complete dispersal is obvious.

The accuracy with which an enemy can aim his bombs will also influence the number of houses which we may build in one town. The less accurate the aim of the attacker the more can the other country afford to deviate from the ideal of complete dispersal. It can then raise the permissible distance between two neighboring towns further above the destruction diameter of the bomb; thus the permissible size of town population will be raised. Since the improvements in accuracy will take time—apart from bombs in the cellar, of course!—the immediate defense measures can be guided by such relaxed standards.

The amount of protection which the scheme of evenly distributed clusters can provide depends very much on their geometrical shape. "Ribbon" or "linear" cities are safer than round clusters.

If the towns are designed as small round clusters with populations as dense as those in our present suburban areas, then the area of the town will occupy a very small part of each circle of the permissible diameter described above. The

attacker could destroy each town with one well aimed appropriately small bomb and thus not waste much of its destructive power. But if we stretch the same number of houses into a narrow ribbon, the enemy will waste most of the destructive force of each bomb in the agricultural land which borders the city.

The "ribbon" or "linear" city is a good compromise between small round clusters and complete dispersal. If all such cities join each other in more or less parallel, continuous ribbons from East to West and are crossed by another network of parallel ribbons from North to South, we have a mesh of squares. Such an arrangement would make for cheaper transportation and other public services than would be possible for round clusters.

It is, of course, unnecessary that the ribbon cities be laid out in exactly straight lines. It is cheaper to adapt the design to the terrain and to existing major communication lines. By curving the ribbons, we can, furthermore, reduce the ability of the enemy to aim along the direction of the cities.

The best spacing for these linear cities depends on the type of an attacker's bomb. About this it is beyond our knowledge to make definite statements. If it is assumed that the bombs will be of the size used at Hiroshima and Nagasaki, a distance of 25 miles between neighboring ribbons is a reasonable one. A more complete dispersal, that is a smaller distance between ribbons, will become desirable only if smaller atomic bombs and extremely high aiming accuracy should be developed. If bombs become bigger, a lesser degree of dispersal, and therefore, a greater distance between ribbons, could be permitted. In this case, however, the proposed spacing of 25 miles will at any rate be safe even though it is smaller than is absolutely necessary. Distributing our population evenly over these lines which run from East to West and from North to South, we should have 15,000 persons on a stretch of 25 miles between two intersections. This means that there would be about 600 people and 160 houses per linear mile along a communication artery. If an efficient transportation and communication system can be provided, some of the desirable characteristics of big cities can thus be maintained.

If an atomic bomb of the Hiroshima type hits an artery, a stretch three miles long will be destroyed. 2,000 people and 500 houses will be affected. This is more than five times the damage that would be caused in case of complete dispersal. But it will not be very easy to hit the communication lines, and even in the worst case much of the destructive power of the bomb is spent on the open regions between linear cities.

GOING UNDERGROUND

As an alternative to dispersal, it might seem safer to go underground, yet it will not be entirely safe. Atomic energy can possibly be used to excite earth vibrations such as occur in earthquakes. If this excitation should prove feasible, buildings deep underground would be open to attack. However, it is probably true that people in underground structures are the most likely to survive an atomic bombing.

Some underground buildings should be constructed for our immediate defense. Strategic factories, offices, and military establishments which must continue to function in wartime and which require a concentration of people will have to be protected and hidden underground. Such schemes are somewhat reminiscent of the Maginot line. (The ill-fate of that fortification system should remind us that while it may be necessary to build a fort, it is disastrous to place one's faith in strong walls alone!)

It is very difficult to specify the depth at which underground buildings should be located. Three to five feet of concrete will give substantial protection. Only rather close hits will damage such a structure. It will be seldom worth while to build a shield thicker than twenty feet of concrete. As already mentioned, in the case of earthquake vibrations mere depth would give no adequate protection. The geological structure of the layers in which buildings are imbedded is more important. Solid rock would seem safest, but excavation in that material is difficult.

Mountains may be used to afford very considerable protection at reasonable cost. Natural or artificial caves can be protected from above by a much thicker shield than could be afforded for underground buildings in flat land. But the supply of water and ventilation will make any kind of underground construction very costly, even if mountains are used.

In order to carry out an adequate program in a reasonable period of time, we shall have to forego elaborate schemes of underground cities. Sheltered structures need only be used for essentials.

A temporary concentration of people for part of the day will be inevitable, even when the dwellings are dispersed. We shall need factories, shops and amusement places. We should attempt to avoid factories which bring together too many people in one place. This is, in fact, the way in which a large section of modern industry already operates. In numerous small plants, parts are produced, and only assembly work is carried on in central plants. Buildings in which, despite decentralization, a great number of people will have to congregate should be placed underground.

TRANSPORTATION PROBLEMS

With our cities stretched out, we shall have to rely more than ever on our transportation system. Is not a vulnerable transportation system such a serious hazard that dispersal becomes undesirable? It is true that adequate communication is a vital part of the plan. It will be necessary to strengthen the transportation system by having several widely spaced highways and single-track railroads along the ribbon cities, and by making the greatest possible use of air transportation, both by commercial airlines and by private plane. If alternative means of transportation are available, one can hope to keep communications open under heavy attack. The long distance rails and highways should not be along the cities but in the middle between them. Alternatively, about one strip in five might be reserved as traffic artery only. Triangular instead of square meshes can be used. They would make for faster transportation in peacetime and for shorter detours in the case of local destruction of roads, although the added mileage required would raise the cost of the program.

It is probably not worth while to put railways underground. Subways are less easy to damage, but less easy to repair. Also they cost more and need more time to build. By insisting on underground railroads, we might postpone and thereby frustrate the whole plan. We may, however, have to put underground the most important railroad stations and the intersection points of the network. These points invite the enemy's fire and must not contain surface structures.

COSTS OF DISPERSAL

How much will the rebuilding cost? Let us first consider the cost of a full program, and then discuss the cost of its successive steps, arranged in the order of urgency. The full program would involve an almost complete replacement of our dwellings, industrial plants, other buildings and a considerable part of our transportation system. A very large part of the business establishments consists of movable equipment which can be transferred to the new locations, but factory buildings, blast furnaces, highways, gas and water pipes, etc., would have to be built anew for the most part.

In estimating the economic burden involved in the program, we are not interested here in the purely financial transfer costs, such as the cost of acquiring existing land facilities. Such costs are not an economic burden, i.e. they do not require the expenditure of labor or of natural resources.

First, let us consider the problem of rebuilding the residential dwellings in the areas designated for relocation. The

* Urban areas are places with a population greater than 2,500.

e, in 1940, about 21 million occupied ling units (apartments or single-ly houses) in the United States lo-l in urban areas.* We can put the age construction cost of a dwelling at about $5,000 (exclusive of land). wing for some increase in population een 1940 and the end of the full re-ion program (say, 1955), we con-e that the total cost of the new dwell-would be about $130 billion. With outlay, every family living in the n areas could be provided with a new e located somewhere else. As long as s up to 50,000 are temporarily pre-ed a sum of about $80 billion will be ed. If only metropolitan districts of illion people or more are dispersed f only certain major key industries, all their personnel and all the neces-services, are recentralized, the cost ill smaller.

e new dwellings should be built so the very poorest conform to minimum dards and thus slums are eliminated. ever, all families would not get hous-f identical quality. The new dwelling s can be distributed by quality among population subject to minimum stand-just as the dwelling units are dis-ted today according to quality. The e of $5,000 is an average computed the construction costs of new houses ifferent qualities and consequently s for a wide variety of dwellings.

e cost of constructing dwelling units be an overestimate for several rea-We may be able to reduce the aver-cost from $5,000 to about $4200-4500 uilding row houses with one wall non to adjacent houses. Row develop-s would be quite applicable to the on" cities that we are considering. also possible that the newly con-ted houses could be built with mate-that are both more suitable and per than brick or wood. Bricks be-missiles under the impact of an sion, and wood is a fire hazard. New-veloped composition boards are safer. may provide equally good houses cheaper cost, if the houses are mass-ced.

condly, we consider the costs of re-ng our industrial facilities, high-, and buildings. There are numerous derations which must be brought to upon the relocation of industry be-we must do the job economically n the framework of safety restric-For example, if there is no conflict the requirements of national defense, facturing plants should be located e they have easy access to raw mate-and markets—and in such a way reduce movements of empty vehicles minimum.

do not have information on the num-f industrial units or their construction cost as we do in the case of residential dwellings. However, we do know the present value of the productive plant and equipment in the hands of private producers and of governments. The privately owned plants exclusive of movable equipment amount in value to about $115 billion measured in present prices, and the governments' buildings and equipment, exclusive of the recent wartime acquisitions, amount to about $45 billion, measured in present prices.

We should attempt to construct a plant which is of the same productive ability as the old plant. New facilities are technologically superior to old facilities. We assume therefore, that depreciated plants which originally cost much more than their current value can be replaced by new plants which do not cost substantially more than the current values and which are equally productive.

The figure of $115 billion includes railway tracks and the figure of $45 billion includes public roads. The length of highways and roads needed for the mesh design is not more than the present mileage, although it is designed in a different way; consequently we do not underestimate the building cost of this type of facilities by our method of calculation.

The total cost of the program to relocate all urban dwellings, plants, and non-movable equipment amounts to about $290 billion, or say $300 billion, a very large figure. We probably cannot carry out a job of this size in ten years, without causing very serious dislocations in our economy. It is true that $30 billion per year for ten years represents a smaller annual quantity of economic resources than that which went into our armaments program, but it is much more than the construction industry at its present size is prepared to handle. At the peak of the war effort, construction amounted to $15 billion per year. We can shift some resources from munitions production to construction and channel the new labor force into the building trades and supporting industries. It seems unlikely that we could raise their annual output in this way to $30 billion without reaching a serious bottleneck or without an all-out effort in training and shifting labor. If we spend $20 billion per year for fifteen years, then the program is more easily within our reach. We could have more consumer goods than we had during the war and still undertake this task.

PRIORITIES OF RELOCATION

Under a fifteen year program we could relocate cities and industries in the order of urgency. Two alternatives present themselves. We can assign highest priorities to the decentralization of the most important key indusries, or we can start with the dispersal of the most vulnerable big cities. If our main consideration is to remove the advantages of an attack the first method is probably to be preferred. One can start with those industries which present particularly attractive targets to the attacker. As another alternative, it would be within our means to relocate all metropolitan areas with populations over 50,000 in the first ten years of the program. The total cost of dispersing and rebuilding the homes and industries of this part of the urban areas is probably not more than $200 billion, an effort which can be accomplished in ten years. We would achieve some degree of safety if all metropolitan areas over 500,000 were dispersed into ribbon cities. The first five years or so of the program should be devoted to these largest cities. As the work goes on, the plan will have to be revised and adjusted to changing conditions and improved knowledge.

The method of financing will have to be the same as was used in the war, namely by taxes, bonds, or both. As in wartime (and as was stated above) it is not the financial method, not the transfer of money that matters, but the full use of labor and natural resources. However, there is a major difference between war and the plan under consideration. During the war, we spent about $300 billion in a shorter time without increasing our stock of wealth. Under the present plan, a similar amount would be spent in rebuilding our country in a better way.

NEW MODES OF LIFE

But we have to consider something else in addition to the cost in labor effort and in natural resources. To live in ribbon cities implies a change in our habits; and the very process of building such cities will temporarily disrupt our lives.

In order to live in ribbon cities we shall have to abandon many of the habits which the people of our big cities have acquired in the course of a century. To be sure, the inhabitants of the new linear cities will not be farmers. Their mode of life will be a suburban not a rural one. They will live near fields but will work in factories and stores. Even if some of their workplaces will be decentralized, life will depend on fast transportation. Is this change in the way of life too high a price to pay for safety? Many modern architects and city planners will probably argue that it is not a price at all; an asset rather than a liability. During the last decades, in the age of the automobile, they have built widely decentralized cities such as the modern Los Angeles. Air travel and cheaper electricity will accentuate the trend even more and our habits would adjust themselves accordingly. Thus, the ultimate change in the habits

(Continued on last page)

Uses of Radioactive Pile Products . Continued from page

These sources of radiation are radio-active materials formed in the pile, which are concentrated into a small bulk and which may then be shipped away in suitable containers. It is not possible to prepare portable sources which will emit gamma rays with the intensity of the pile itself, nor is it generally possible to prepare strong sources of neutrons. For most purposes, however, such concentrated, portable sources of beta and gamma rays as are available will be convenient and more than adequate.

Radioactive materials may be produced in the pile by two methods: (1) isolation of fission products, and (2) activation of foreign substances placed in the pile. If the desired radioactive element is one of the fission products, it may be secured by removing some of the uranium from the pile and separating the desired fission product by chemical procedures. If the desired radioactive element is not one of the fission products, it can be prepared by putting a normal piece of that element into a thin walled tube which extends deep into the pile. Inside the pile it receives a tremendous bombardment with neutrons, and is thereby made radioactive. The radioactivity thus produced decays away at the normal rate characteristic of that element, so that the radioactivity persists after the material is removed from the pile.

USES OF RADIOACTIVITY

The use of radioactivity falls into two categories: (1) the employment of the energetic and very penetrating radiations emitted by piles or radioactive elements, and (2) the use of the property of radioactivity as a "tag" for the atoms possessing it (the method of "radioactive indicators" or "radioactive tracers").

1. Use of Radiations

Industrial Uses. A number of uses are already known for sources of intense, highly-penetrating radiation. Gamma-ray emitting radioactive materials may be used as cheap, portable sources of radiation for "X-raying" large pieces of metal and other opaque materials for the detection of flaws. They may be used in automatic regulators of various types, in which the radiations can be used to set off control mechanisms. High intensity radiations may have a great effect upon industrial chemistry. Just as sunlight bleaches many coloring materials, so many other chemical reactions—some of considerable importance industrially—can be made to take place when intense gamma-rays are used.

Medical and Biological Uses. Some types of medical treatment involve the irradiation of portions of the patient's body. Certain types of cancer, for example, yield to neutron irradiation, and others to gamma-ray irradiation. Either type of treatment can be given to many patients at the same time if a pile is available. Or gamma-ray emitting materials produced in the pile may be used instead of radium. Such materials will be cheap and plentiful where radium has been expensive and rare. Because of the wide variety of substances emitting gamma- and beta-rays, the substance used can be chosen to fit the particular case. For example, if a short, intense irradiation is desired, a radioactive substance of short life time may be introduced into the desired area. After a short time, it will have disappeared by radioactive disintegration.

Another method of using the radiations from radioactive substances in therapeutic work is by feeding or injecting them in a form which may be stored in the affected organs. Thus, radioactive phosporous has been administered in the treatment of leukemia, being concentrated in the blood-forming organs; and the concentration of radioactive iodine in the thyroid gland has been used to treat thyroid disease. Since stronium tends to be concentrated in the bones, it has been suggested that radioactive stronium can be used in the treatment of bone tumors. These are some of the procedures tried before the war; with the availability of large quantities of all kinds of radioactive materials, from radioactive phosphorous to radioactive arsenic, many more similar uses will be developed.

We must avoid assuming, however, that a universal cancer cure is just around the corner. Some tumors are actually more resistant to rays of all kinds than the normal body tissues, which must, of course, remain relatively undamaged during the treatment. Moreover, there is still no curative treatment for cancer which has become disseminated throughout the body. We are justified, however, in believing that many improvements in cancer treatment will follow the investigation of the use of new radioactive substances, just as experience and wisdom have constantly improved the results from the use of radium and X-rays.

2. Use of Radioactive Materials as "Tracers"

A most important use of radioactive substances depends upon the fact that extremely sensitive instruments (e.g., "Geiger-Muller counters") are available for the detection of the radiations from radioactive materials. It is possible to detect the presence of very tiny amounts of these substances. For example, it is possible to detect a millionth part of a millionth of an ounce of radium. If radioactive material is added to non-radioactiv material, it is possible to follow the mix ture by using instruments to determin where the radioactivity has gone. Fo example, it is possible to follow the flo of gas through a complicated system o pipes and reactors, by adding a sma amount of a radioactive gas and follow ing the migration of the radioactivit with a "Geiger-Muller counter." This an example of the simpler of the tw types of uses for a "tracer," namely, fo lowing the bulk movement of a liqui gas, or solid.

In the second type of application, radi active tracers are used to follow a partic lar chemical component of a mixture. T take a specific example, if copper di appears from a solution as it flov through a system of pipes, it is possib to determine where the copper is bein lost. When a small amount of radioacti copper is added to the solution, this radi active copper travels with the norm copper and is lost at the same place. Th region can then be located by using a G ger-Muller counter to detect the gamn rays emitted by the radioactive copper.

The use of such specific radioacti tracers depends upon the fact that forms of an element have essentially t same chemical and physical properti Thus, the element cobalt normally is co posed of atoms called cobalt-59. Wh bombarded with neutrons, another fo of this element is made, called cobalt- which is a radioactive substance. It h a life time measured in years, and d integrates by emitting a beta-ray and gamma-ray. The stable atom cobalt- and the radioactive atom cobalt-60, o they are mixed, will travel togeth through any kind of chemical reacti Thus, the whereabouts of a large amou of ordinary cobalt (cobalt-59) may followed by "tracing" a minute amou of cobalt-60 mixed with it.

Industrial Uses of Tracers. Radioact tracers already have been used industri ly to measure the flow of liquids and ga in the manner of the example given abo Thus petroleum engineers have used r ium as a tracer to map oil pools. Radi mixed with oil is pumped down a w and its distribution is measured by radioactive properties. Because of great sensitivity of methods for det ing radioactive materials, it is poss to find the radium even after it has come greatly diluted by being spr through a large pool.

Radioactive elements may greatly s plify chemical analysis problems in pl production work, such as the refining steel. Very often it is necessary to up a process until a time-consuming ch

analysis has been made by the lab-ory. If a tracer is introduced at the nning of the process, it is possible to up simple, quick, and often automatic yses by radioactivity measurement h will eliminate the usual holdup. a process has been patented for fol-ng phosphorous in steel refining.

ydrogen is one of the important ele-ts composing petroleum. Radioactive rogen used as a tracer has already lied valuable information as to what on in the process of "cracking" petro-, a process which produces high-ity gasoline and other valuable chem-. It has been possible to find out a t deal about what occurs to the com-ted molecules comprising petroleum ng the cracking process, and such ledge inevitably leads to improve-s and new developments.

emical Resarch Uses of Tracers. The of tracers in general scientific re-h will certainly expand tremendous-soon as the materials are available. organic chemist, for example, is con-d with a vast number of compounds osed to a large extent of carbon and ogen. As mentioned before, a radio-e form of hydrogen is available; a active carbon has also been made. these two, the organic chemist may le to determine just what happens to ic molecules when he heats them, ils them, or causes them to react. such knowledge, he can learn how ake them more easily, and more ly; and he can learn how to make and more useful compounds. Con-ing that a very great portion of our ical industry is based upon organic istry, basic advances in this field sure to exert great influence. This y an example of what the availability dioactive tracers for all the elements ean to chemical research.

logical and Medical Uses of Tracers. of the important uses of tracers in y and medicine is to find out how uman body functions. It has been xperience of the past, that when knowledge is available, methods of ing cures for diseases are greatly ified. When bacteria could be iden-under the microscope, the attack cterial diseases became much easier. se of tracers made by cyclotron bom-ment has already revolutionized much ical and medical research, because iments may be attempted which are sible without tracers.

ne of the uses of radioactive tracers airly obvious. Thus, the rate at which ood flows through arteries and veins asily be measured by injecting the r at one point and measuring the which elapses before it arrives at the point where the detecting device is placed. In a similar fashion, the rate at which sap rises in plants may be found directly.

The concentration of a substance in a certain part of the body can be directly demonstrated. The accumulation of iodine in the thyroid can be shown by placing a counter on the neck after radioactive iodine is administered. This method has been used to study the nature of various diseases of the thyroid, in which the gland may be avid for iodine, or may refuse to store it. It is also possible to determine, by injecting a very small amount of radioactive iodine into a patient with thyroid cancer, whether it is worth while to treat the patient with a much larger amount, or whether operation is called for.

These and similar uses of radioactive tracers hardly scratch the surface of the possibilities. Minute, non-poisonous amounts of drugs, vitamins, and poisons can be followed around in the body by the radioactive tracer method, because of the great detection sensitivity. "Tagged" drugs will shed new light on the site and mode of action of therapeutic agents (such as the "sulfa" drugs and penicillin) and allow a totally new approach to medication. Moreover, the greatest value of this method lies in what it can tell us about those normal body processes whose investigation defies ordinary chemical methods.

We know, for instance, that the body continually requires food, that a great variety of foods must be eaten, and that some are "burned" in the body and produce heat. We have found out, by very difficult and painstaking experiments, the identity of a great many of the chemical compounds which are formed in the body from the food originally taken in. If we analyze an organ at two different times, the analysis often does not show any appreciable change, so that is it usually impossible to tell what has been happening between these two analyses. All of the subtle vital processes can be studied relatively easily and in great detail by using tracers, for we can make one of the normal body compounds in a radioactive form, administer it, and then follow the complete history of the "labelled" molecules. The course of phosphorous in the body has been traced in great detail in this fashion.

This method has already shown that many of the structures of the body, which had always been considered to be stable, are really changing, breaking down and rebuilding, at great rates of speed. These changes can now be watched, and it is fair to say that the method gives us a wholly new conception of body and cell processes. Such a revision of our basic ideas leads in turn to changed interpretations of health and disease, greatly affect ing medical practice.

In plant biology, the tracer method has already shown itself to be of great importance. One of the most puzzling and important problems of science is "How do plants manufacture sugar out of carbon dioxide, water, and sunlight?" If man could duplicate this process of "photosynthesis," first in the laboratory and then on an industrial scale, the bountifulness of the earth might be greatly multiplied. The world's fuel and food supplies would be assured as long as the sun continues to emit light. A most powerful tool at the disposal of the chemist and biologist for understanding, and perhaps eventually duplicating photosynthesis, is the tracer, radioactive carbon, which has been mentioned before. If, as a result of our greatly increased production of radioactive carbon, the riddle of photosynthesis is solved, that, and not power plants or atomic bombs, will stand as the greatest achievement of atomic energy release.

SUMMARY

The most significant uses of artificial radioactive materials will be in laboratory researches in which the tagging of atoms through their radiations will enable technical advances to be made whose very nature cannot be predicted at this time. Just as the experiments of Fermi in 1934 led, all unexpectedly, to the production of the atomic bomb and other atomic energy sources in 1945, so the final results of such "tracer" researches and their influence on life even a few years from now cannot be adequately anticipated. But the effect will be great. A necessary condition for obtaining these benefits, however, is an enlightened attitude towards the control and release of radioactive materials and information concerning the methods for using them.

For the purposes of manufacturing radioactive materials or for using pile radiations, it is not necessary to have piles which can supply industrial power. Piles incapable of delivering useful power can still supply adequate amounts of radioactive materials to all users and can also serve as strong sources of gamma and neutron radiation. In order to simplify the problem of international control of atomic weapons, it may be considered necessary to delay for a time the use of atomic power on a large scale since the power installations may be used to form quantities of fissionable material which could be used in bombs. Even if this postponement occurs, it will not be necessary to delay at all the great benefits derivable from the use of radioactive materials.

First Power Pile To Be Built at Clinton

A press release on April 12 by the Manhattan Engineer Project revealed that an experimental atomic power plant is to be built at the Clinton Engineer Works at Oak Ridge, Tennessee.

In broad and general terms the new pile will employ scientific principles utilized in the Chicago pile where the first chain reaction in history took place, the Clinton Laboratories pile, where the first experimental quantities of plutonium were made, and the full-scale pile at Hanford, Washington, where plutonium is produced. But unlike the others, which were made specifically to produce plutonium, the atomic power plant will have as its primary purpose, the generation of heat energy and the conversion of that energy into electricity.

The pile will be based on investigations carried out at the Metallurgical laboratory of the University of Chicago on the initiative and under the leadership of its present director, Dr. Farrington Daniels,

The Monsanto Chemical Company will have the overall authority and responsibility for design, construction and operation of the plant.

Dr. Charles Allen Thomas, Vice-President and Technical Director of Monsanto, will be in charge of the project. He headed studies in the chemistry and final purification of plutonium and since July 1, 1945, when Monsanto succeeded the University of Chicago as operators of Clinton Laboratories, has been in general charge of Clinton Laboratories. Dr. Thomas also is one of the members of the Lilienthal board responsible for the State Department Report on international control of atomic energy.

General Groves stated that "Assignment of the work to private industry is in keeping with the line of policy successfully pursued in the Manhattan District work to date."

A meeting was held April 11 in New York to formulate plans for organization and to secure the cooperation of the many diverse organizations necessary to develop atomic energy for power purposes. Representatives of the Manhattan Engineer District, the Army Air Forces, U. S. Navy, Monsanto Chemical Company, the Metallurgical Laboratory of the University of Chicago and Allis-Chalmers, General Electric, and Westinghouse, industrial firms that helped develop the atomic bomb, attended the meeting.

It is expected that actual construction will get under way this year. The initial expenditure for the experimental unit has been tentatively placed at two and one half million dollars. The pile may be ready to operate sometime late this year, or early next year.

The release stressed the experimental character of the new pile:

"Although the plant will produce some electricity it probably will not be an economic unit for such production and is not so intended. This is to be a pilot plant: a research tool from which knowledge will be derived for subsequent development and exploratory work. It must, therefore, be used in the light of a scientific and engineering experiment rather than an economically practical appli tion of nuclear fissions for generation electricity.

Primary consideration is the need reduce to practice some of the many id for power piles developed as an growth of the atomic bomb program to supply evidence that might be of va in clarifying any international pat situation that might arise. Patent rig growing out of the work will be ves with the government of the United Sta and Congress will determine the use which they will be put.

ATOMIC BOMB TESTS

BIKINI TEST PLANS

After the postponement of the first Navy test from May 15 to July 1, considerably congressional opposition developed to holding these tests at all. Senator Huffman of Ohio introduced a resolution requesting President Truman to abandon the experiments. He was supported, among others, by Senator Lucas of Illinois, and Senator Walsh of Massachusetts, Chairman of the Committee on Naval Affairs. The Huffman resolution was tabled, and Senator Huffman may ask the Senate to call it up at any time. On the other hand, the necessity of the test for the determination of future defense program was strongly defended by military and naval authorities. Supporting their attitude, President Truman issued a statement on April 12 announcing that the tests will be held as scheduled:

The President's Statement

Preparations for the atomic bomb tests in the Pacific are being pressed forward and I have been assured that the present target dates for the explosions will be met. I am in complete agreement with the Joint Chiefs of Staff and the Secretary of the War and the Secretary of the Navy in their view that these tests are of vital importance in obtaining information for the national defense.

Without the information from these experiments, designers of ships, aircraft and military ground equipment, as well as our strategists, tacticians, and medical officers, will be working in ignorance regarding the effects of this revolutionary new weapon against naval and other targets not previously exposed to it.

These tests, which are in the nature of a laboratory experiment, should give us the information whirh is essential to intelligent planning in the future and an evaluation of the effect of atomic energy on our defense establishments.

Senator Huffman asserted that, despite the President's statement, he still would press for passage of his resolution.

The bill authorizing the use of ships for the atom bomb tests has been sent back to the Naval Affairs Committee fo revision of the target ship program. Thi step was caused by criticism of the larg number of ships scheduled for use i the first test according to the origina plans. Senator Walsh said on April 1 that he expected the number of ships t be reduced from 100 to 71.

NAVY ANNOUNCES BOMB TEST EVALUATORS

The seven members of the Joint Chief of Staff Evaluation Board for the atomi bomb tests to be held at Bikini Atoll i July were announced on March 28. The are: from the Army, Gen. Joseph W Stillwell and Gen. Lewis H. Brereto from the Navy, Vive Admiral H. H. Hoov er and Bradley Dewey; and one civilia from the Army's Manhattan District, F. Farrell.

A LAND TEST?

A proposal that the atomic bomb tested on a mock city as well as on fleet in Pacific waters was made on Apr 8 by Dr. Karl T. Compton, president the Massachusetts Institute of Techn ogy. It is more important to know wh the atomic bomb will do to a land targ than it is to know what it will do to sea target, Dr. Compton said.

He advocated the construction of "city" in some uninhabited place, co sisting of walls and roofs containing eve known kind of structural material so th the effects of the bomb on them mig be determined.

LIE PRODS ATOMIC ENERGY COMMISSION MEMBERS

Trygve Lie, Secretary General of United Nations, called on April 4 on laggard member nations of the Ator Energy Commission to appoint delegat in order that the business of devisi world control of atomic energy may begun in earnest as soon as possible.

Those nations which have not yet pointed delegates include China, Mexi and the Soviet Union.

he British Atomic Energy Project . . .

e difficulties encountered in the de-
ment of the new British Atomic
gy Project at Didcot, England, have
mentioned in John Simpson's article
e last issue of the Bulletin. Addi-
l interesting details on this Project
given by Peter Whitney, in a report
e Chicago Sun.

• • • •

ar the little village of Harwell, five
tes' drive from Didcot in the Thames
y, is a Royal Air Force airfield
eventually is to become Britain's
al atomic research plant.

ns to this effect were announced last
29, but Harwell still is an R.A.F.
ome.

cloak of secrecy, enforced by Brit-
painfully honest Civil Service and
ted on unwilling scientists, keeps
ell's progress, or lack of it, out of
apers and out of the people's minds.
e R.A.F. policeman at the gate won't
ny newspaperman into Harwell with-
permit from the Ministry of Supply,
the Ministry of Supply won't issue
its.

ere's nothing to see there anyway,"
ficial said blandly. "We haven't even
a hanger to ourselves yet. They're
g to arrange for space in a corner
e of the hangers for the time being."

netheless, a staff is being recruited
gh regular Civil Service personnel,
ies beginning at 275 pounds—$1,100
ear.

en when it gets under way, Harwell
be no Manhattan Project. The sta-
Attlee told the House, will cost an
l $4,000,000 and will cost $2,000,000
r to run.

der the circumstances, small wonder
some voices in Britain have been
l in complaint that the government
lf-hearted, that Sir John Anderson,
rincipal adviser of atomic questions,
pinchpenny Scot, and so forth.

pt. Raymond Blackburn, young Labor
has distinguished himself in this
Parliament by persistent and knowl-
ble questions on atomic matters.
as estimated the cost of an atomic
rch project "sufficient to insure
industrial future of this country
st the competition of any other
" at $135,000,000.

e designated director of Harwell,
J. D. Cockcroft, is on loan to the
dian government, for whom he is di-
r of atomic experiments. Announ-
his appointment in the House, Attlee
that "it has been arranged with the
dian authorities that he is to remain
nada for the present."

allenged on the slow motion of the
nment's atomic plans, Attlee's answer always has been: "We are co-operating in this matter with the United States and Canada, and the House will understand that no statement can be issued without consultation with them."

What Britain's leaders evidently are thinking is that the country cannot afford now this enormous expenditure on a purely military basis; the money is needed to rehabilitate British industry and pay back British debts to the outside world.

Meanwhile, research on a scale that would have seemed very handsome before the war can be carried out, until the actual industrial potential of atomic fission is ascertained.

But first, as Attlee discreetly indicated to the House, Britain's main effort for the time being must be to obtain uranium ores sufficient for research. A special division of the Supply Ministry, under the top-flight leadership of Lord Portal, wartime commander in chief of the R.A.F., will have that job.

Shils on State Dep't Report . . . . . Cont.

(Continued from Page 7)

If there develop strong cultural and psychological resistances among scientists and engineers to this arduous inspectional work as a life-long career, then the Personnel Department will have to face a situation in which appointments will be for short-terms and in which therefore it will be necessary to recruit a much larger number of persons. This will make the burden of personnel selection, administration and training a much greater one, but it may be the only way in which the interests of men of high quality will be satisfied and their services won for the ADA.

Special care will have to be given by the Personnel Department to the assignment problem. Scientist- and engineer-inspectors will have to be chosen not just with reference to their technical suitability and their adaptability to the culture of the country to which they are sent. They will also have to be acceptable to the States whose security will rest on the reliability of the inspectorate. One of the ways to do this will be to guarantee minimum representation of various nationalities in the ADA missions to the member States so that each State and people will be able to feel that its safety in other countries is being watched over by its own nationals. Again this will provide subtle problems for the recruitment officers of the ADA who will have to discover personalities who possess in addition to technical qualifications, that type of detachment and balance which will harmonize loyalty to one's own country with loyalty to an international institution and to mankind at large. Otherwise, they will not be acceptable.

Conclusion

The Acheson report provides not only a central scheme but a series of steps for its realization. Great political dangers are resident in this type of inspection and the succession of these steps. Until the consummation of the last step, the United States will retain the monopoly position which is at present one of the disturbing factors in the international situation. As long as this monopoly exists other states will have a very strong incentive to prospect for uranium, to conduct militarily relevant research and experimentation and to build up stockpiles of fissionable materials and bombs, if they are able. If the various states have time to build up stockpiles or plants or laboratories before the inspection scheme comes into operation, then subsequent detection will be extremely difficult for the type of inspection envisaged in the Acheson Report. Already existing stockpiles and equipment which are not voluntarily disclosed are detectable only by "snooping" which the Report regards as repugnant and as something to be kept at a minimum. (Actually, more of this will be required than the Report is willing to acknowledge.) But if the United States were to renounce its monopoly without concern for the simultaneous establishment of the international control scheme, the military security of the United States would be reduced. Nor would it be reasonable to expect the American people or their government to acquiesce in the renunciation of their cherished secrets without a guaranteed return.

We will discover the resolution of the dilemma when we recognize the burning urgency of the problem. In August of last year, Mr. Churchill in the House of Commons said that we have very few years in which to remake human relations or to await destruction. The Acheson report, with its proposals for new tasks for an international scientific elite, aware of and bearing its heavy responsibilities, and for totally new and fertile types of international institutions is a great and noble contribution to the remaking of human relations for which Mr. Churchill called. Its fruit will however wither unless the American people and their government proceed with the greatest speed to discuss, understand and accept the proposals of the Report and then by their prestige, power and wealth obtain its acceptance by the other major states of the earth before it is too late.

Dispersal of Cities

(Continued from Page 15)

of life is perhaps not a serious price to pay for safety.

The difficulties of the transition are probably less acceptable. It will require much government regulation. We have just gone through a war which has required an increase in the government interference in our life. The government allocated raw materials and regulated the flow of labor. The rebuilding of cities and industries will similarly require the allocation of space; the government in cooperation with management and labor will have to decide about the best location for the key industries, and the order of urgency for their decentralization. The master plan of network cities and communications will have to be adopted in advance. But we need not decide now how much can then be left to the free and automatic flow of labor and enterprise which will follow the relocated key industries along the main communication arteries. This decision will depend upon the time allowed for the completion of the program. The shorter the time, the less can we rely on the free movement of labor and the free planning of private enterprise.

We are in a grave situation. We shall have to use all our intelligence and all our industry to save human lives. One part of this difficult task may be to rebuild a large part of our homes and plants. It is possible that we cannot do this without government regulations, just as restrictive or more restrictive than those of the recent war years. We may have to comply for the sake of temporary safety in order to gain time in which to establish understanding, friendship, and firm unity between nations.

CONTRIBUTORS:

Edward A. Shils: Assistant Professor of Sociology, University of Chicago; Assistant Director of Office of Inquiry into the Social Aspects of Atomic energy.

Jacob Marshak: Professor of Economics, University of Chicago; Director of Cowles Commission for Economic Research.

Edward Teller: Professor of Physics, University of Chicago; and of Institute for Nuclear Studies.

Lawrence R. Klein: Post-Doctoral Fellow of Social Science Research Council; Research Associate of the Cowles Commission.

KANSAS MEETINGS

A tour including eight Kansas towns was arranged by the Volker Foundation at the University of Kansas; Mr. Hilden Gibson of the Department of Sociology was in charge of the arrangements. Six scientists from different laboratories,—L. Borst, T. Jorgensen, D. Hill, H. Brown, D. Hume, P. Henshaw and J. Nickson—participated in the tour.

The program included morning, afternoon, and evening sessions at Kansas City on April 1, Topeka on April 2, Sabina on April 4, Hays on April 5, Dodge City on April 6, Wichita on April 8, Chanute on April 9, and Pittsburgh on April 10.

The audiences included selected community leaders; they were not picked with an eye to any particular political leanings.

The scientists who participated in the sessions were impressed by the open-mindendness of the audiences, their eagerness to be informed and willingness to consider the situation on its own merits, without reference to nationalism, internationalism, isolationism, and similar general attitudes.

Resolutions supporting the Acheson report and civilian control of atomic energy were passed, and standing committees on atomic energy were established in several communities.

The scientists who took part in the trip agreed that it was very effective in spreading information and awakening the interest of the country. They suggested that similar programs should be carried out in as many other states as possible.

BOMB MAKING HOLIDAY SUGGESTED

Twelve professors of the Columbia University at New York have suggested, in a letter to the New York Times, that in order to improve the atmosphere for the discussions of the UN Atomic Energy Commission, the United States government should cease the production of atomic bombs and interrupt for one year the production of pure plutonium and uranium 235. The signers are L. C. Dunn, I. Edman, A. P. Evans, Selig Hecht, P. C. Jessup, R. M. MacIver, Edgar Miller, F. C. Mills, George B. Pegram, I. I. Rabi, Jan Schilt and C. S. Shoup, professors, respectively of zoology, philosophy, history, biophysics, public law, sociology, biochemistry, economics, dean of graduate faculties, physics, astronomy and economics.

TWO NEW YORK GROUPS MERG

As a result of the gradual liquidati of the New York Laboratories of t Manhattan Project, the members of t Association of Manhattan Project Scie tists, New York City Area, have merg their organization with the city-wi Association of New York Scientists. a joint meeting of the two organizatio the following Executive Committee the combined organizations was electe Clarke Williams (Chairman), Hugh Wol (Secretary), Nordsieck, Philips (Trisc ka as alternate), Gregerson, Grundfe Mirsky, Spock, Kirk, Swartz, Rosenbe Adler, Murphy and Kaplan. I. Kapl has been designated as the ANYS re resentative on the FAmS council.

FAmS COUNCIL MEETS

A meeting of the Council of the Fe eration of American Scientists is to ta place at Pittsburgh, on April 20-21. T main topics of discussion are the attitu towards the McMahon bill in its prese form and the appraisal of the State D partment Report on the Internatio Control of Atomic Energy. Propos pertaining to future educational progr of the Federation and organizatio reforms also will be discussed.

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EDITORS:

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.ETIN of the
TOMIC SCIENTISTS . . .

1 MAY 1, 1946 No. 10

EFORE HIROSHIMA

has been mentioned publicly on several occasions that before the first atomic bomb was exploded over Japan, ists attempted to convey to the government their views e social and political implications of the release of atomic y, particularly its use for military purposes.

ne Army has now released for publication, with insignifi- deletions, a report presented on June 11, 1945—two months e Hiroshima—to the Secretary of War, by a "Committee cial and Political Implications," appointed by the Director e Metallurgical Laboratory in Chicago. It consisted of three cists, three chemists and one biologist, under the chairman- of Professor James Franck.

ne report of June 11 was not the first formulation of the which prevailed among scientists on the effect of the c bomb on warfare, the possibilities of defense, the dan- of an atomic armaments race and the necessity for inter- nal control of atomic energy. In fact, these ideas—which Hiroshima have become familiar by their repetition in ically all public statements on atomic energy emanating scientific sources—became crystallized in the minds of scientists on the Project as early as 1943 and 1944, and expression in several individual and collective memoran- What caused the report of June 11, 1945 to be somewhat ent from its predecessors, was the fact that by then the n Europe had ended, and the danger of the enemy countries oping the bomb first had disappeared, while at the same the question of the use of the bomb against the remaining y—Japan—had become acute because of our own progress. report was dispatched to Washington six days before the Mexico test explosion!) This has caused the "Committee ocial and Political Implications" to supplement general derations of future policy with a discussion of the prac- problem—shall America use atomic bombs in the Japanese and, if so, how shall they best be used?

ne main conclusion reached by the Committee was that the f the bomb should be considered as a fateful political de- , and not merely as a matter of military tactics. Antici- g that within a few years after the beginning of a race omic armaments, other large nations will be able to make own atomic bombs, and that in a world armed with such s, the security of the United States will be gone, and her cities and industrial concentrations will be extremely vul- le to devastating attack, the Committee argued that the ary political-military aim of America should be the pre- on of atomic wars in future. From this point of view, the nittee felt that America should not first introduce the c bomb as a legitimate means of warfare, by using it for rprise attack on Japan. Instead, the report proposed, as rst step, a demonstration of the bomb to the nations of the l, including Japan, in an uninhabited locality.

ne report was agreed upon unanimously by the seven sci- s on the Committee. It undoubtedly expressed the opinion considerable group of scientists at the Project. It cannot , however, to be the official expression of view of the sci- s on the Project. There were undoubtedly among scien- those who felt that the way to obtain the maximum possible effect of the bomb in shortening the war and reducing American (and incidentally also Japanese) casualties, lay in an all-out attack by the new weapon on Japanese homeland. Organizations such as the Atomic Scientists of Chicago or the Association of Oak Ridge Scientists, which could speak authoritatively for a large majority of scientists on the Manhattan Project, were formed only three months later, and had no opportunity to express their opinion on the use of the atomic bombs at Hiroshima and Nagasaki; this was water over the dam, and there appeared to be no reason to risk disagreements on past events when the groups of scientists were all united on what the future developments should be.

Between the transmittal of the report to the Secretary of War on June 11, and the dropping of the first bomb on Japan on August 6, two developments took place. One was a petition to President Truman, signed by 64 scientists associated with the Metallurgical Project. The authors of this petition felt that the Committee report, sent through the official War Department channels, was not enough, and that an appeal sent directly to the President and carrying the signatures of individual scientists, would be more effective.

The other development was a poll of scientists to which Dr. A. H. Compton has recently referred in a public statement. This poll, taken on Dr. Compton's request by the Director of the Metallurgical Laboratory, presented five alternatives, ranging from the all-out use of the atomic bomb "as the Army may see fit," through "demonstration on a military objective," and "demonstration in an uninhabited locality," to "no use in Japanese war at all" and "keeping the existence of the bomb a secret." Over 150 scientists took part in the poll, with over one-half voting for "preliminary demonstration on a military objective," about one- third for "preliminary demonstration on uninhabited locality," and small groups for all-out use, or no use under any conditions.

Opinions will necessarily be divided as to whether the destruction of Hiroshima and Nagasaki with over 200,000 casualties was a "demonstration on a military objective, (as was implied in Dr. Compton's speech) or an "all-out use at the discretion of the Army."

There is no doubt that the two bombs dropped on Hiroshima and Nagasaki brought the war to an immediate conclusion and thus saved many casualties; it is also a matter of fact that no great opposition to the use of the bomb has developed after the fact either in this country or abroad, apart from some statements mainly by religious groups (including such authoritative ones as the Vatican and the Federal Council of Churches in America).

Whether the capitulation of Japan could have been brought about by a mere demonstration of atomic weapons, nobody will ever be able to tell with certainty. Whether the difficult task of achieving international arrangements capable of preventing future atomic wars has been made still more difficult by the decision to use the bombs in Japan, will also remain a matter of speculation. We reprint the June 1945 report not to invite recriminations or criticism of the decisions of our government, but because we believe it to be a document of historical interest.

A Report to the Secretary of War . . . . June 194

I. Preamble

The only reason to treat nuclear power differently from all the other developments in the field of physics is the possibility of its use as a means of political pressure in peace and sudden destruction in war. All present plans for the organization of research, scientific and industrial development, and publication in the field of nucleonics are conditioned by the political and military climate in which one expects those plans to be carried out. Therefore, in making suggestions for the postwar organization of nucleonics, a discussion of political problems cannot be avoided. The scientists on this Project do not presume to speak authoritatively on problems of national and international policy. However, we found ourselves, by the force of events, during the last five years, in the position of a small group of citizens cognizant of a grave danger for the safety of this country as well as for the future of all the other nations, of which the rest of mankind is unaware. We therefore feel it our duty to urge that the political problems, arising from the mastering of nuclear power, be recognized in all their gravity, and that appropriate steps be taken for their study and the preparation of necessary decisions. We hope that the creation of the Committee by the Secretary of War to deal with all aspects of nucleonics, indicates that these implications have been recognized by the government. We believe that our acquaintance with the scientific elements of the situation and prolonged preoccupation with its world-wide political implications, imposes on us the obligation to offer to the Committee some suggestions as to the possible solution of these grave problems.

* * *

Scientists have often before been accused of providing new weapons for the mutual destruction of nations, instead of improving their well-being. It is undoubtedly true that the discovery of flying, for example, has so far brought much more misery than enjoyment and profit to humanity. However, in the past, scientists could disclaim direct responsibility for the use to which mankind had put their disinterested discoveries. We feel compelled to take a more active stand now because the success which we have achieved in the development of nuclear power is fraught with infinitely greater dangers than were all the inventions of the past. All of us, familiar with the present state of nucleonics, live with the vision before our eyes of sudden destruction visited on our own country, of a Pearl Harbor disaster repeated in thousand-fold magnification in every one of our major cities.

In the past, science has often been able to provide also new methods of protection against new weapons of aggression it made possible, but it cannot promise such efficient protection against the destructive use of nuclear power. This protection can come only from the political organization of the world. Among all the arguments calling for an efficient international organization for peace, the existence of nuclear weapons is the most compelling one. In the absence of an international authority which would make all resort to force in international conflicts impossible, nations could still be diverted from a path which must lead to total mutual destruction, by a specific international agreement barring a nuclear armaments race.

II. Prospects of Armaments Race

It could be suggested that the danger of destruction by nuclear weapons can be avoided—at least as far as this country is concerned—either by keeping our discoveries secret for an indefinite time, or else by developing our nuclear armaments at such a pace that no other nations would think of attacking us from fear of overwhelming retaliation.

The answer to the first suggestion is that although we undoubtedly are at present ahead of the rest of the world in this field, the fundamental facts of nuclear power are a subject of common knowledge. British scientists know as much as we do about the basic wartime progress of nucleonics—if not of the specific processes used in our engineering developments—and the role which French nuclear physicists have played in the pre-war development of this field, plus their occasional contact with our Projects, will enable them to catch up rapidly, at least as far as basic scientific discoveries are concerned. German scientists, in whose discoveries the whole development of this field originated, apparently did not develop it during the war to the same extent to which this has been done in America; but to the last day of the European war, we were living in constant apprehension as to their possible achievements. The certainty that German scientists were working on this weapon and that their government would certainly have no scruples against using it when available, was the main motivation of the initiative which American scientists took in urging the development of nuclear power for military purposes on a large scale in this country. In Russia, too, the basic facts and implications of nuclear power were well understood in 1940, and the experience of Russian scientists in nuclear research is entirely sufficient to enable them to retrace our steps within a few years, even if we should make every attempt to conceal them. Even if we can retain our leadership in basic knowledge
of nucleonics for a certain time by ma
taining secrecy as to all results achiev
on this and associated Projects, it wou
be foolish to hope that this can prot
us for more than a few years.

It may be asked whether we cann
prevent the development of military nuc
onics in other countries by a monopoly
the raw materials of nuclear power. T
answer is that even though the larg
now known deposits of uranium ores a
under the control of powers which belo
to the "western" group (Canada, Belgi
and British India), the old deposits
Czechoslovakia are outside this sphe
Russia is known to be mining radium
its own territory; and even if we do n
know the size of the deposits discover
so far in the USSR, the probability th
no large reserves of uranium will be fou
in a country which covers one-fifth of t
land area of the earth (and whose sph
of influence takes in additional territor
is too small to serve as a basis for secu
ty. **Thus, we cannot hope to avoid a n
clear armament race either by keepi
secret from the competing nations t
basic scientific facts of nuclear power
by cornering the raw materials requi
for such a race.**

We now consider the second of the t
suggestions made at the beginning of t
section, and ask whether we could not f
ourselves safe in a race of nuclear arm
ments by virtue of our greater industr
potential, including greater diffusion
scientific and technical knowledge, grea
volume and efficiency of our skilled la
corps, and greater experience of our m
agement—all the factors whose impo
ance has been so strikingly demonstra
in the conversion of this country into
arsenal of the Allied Nations in the pr
ent war. The answer is that all that th
advantages can give us is the accumu
tion of a larger number of bigger a
better atomic bombs.

However, such a quantitative advanta
in reserves of bottled destructive pow
will not make us safe from sudden atta
Just because a potential enemy will
afraid of being "outnumbered and o
gunned", the temptation for him may
overwhelming to attempt a sudden unp
voked blow—particularly if he should s
pect us of harboring aggressive intenti
against his security or his sphere of
fluence. In no other type of warfare d
the advantage lie so heavily with the
gressor. He can place his "infernal m
chines" in advance in all our major cit
and explode them simultaneously, t
destroying a major part of our indus
and a large part of our population, agg
gated in densely populated metropoli
districts. Our possibilities of retaliatio
even if retaliation should be conside

quate compensation for the loss of ions of lives and destruction of our est cities—will be greatly handicapped use we must rely on aerial transpor- on of the bombs, and also because we have to deal with an enemy whose stry and population are dispersed over rge territory.

* * *

fact, if the race for nuclear arma- ts is allowed to develop, the only ap- ent way in which our country can be ected from the paralyzing effects of a len attack is by dispersal of those in- ries which are essential for our war t and dispersal of the populations of major metropolitan cities. As long as ear bombs remain scarce (i.e. as long ranium remains the only basic mate- for their fabrication), efficient dis- al of our industry and the scattering ur metropolitan population will con- rably decrease the temptation to at- us by nuclear weapons.

t present, it may be that atomic bombs be detonated with an effect equal to of 20,000 tons of TNT. One of these bs could then destroy something like uare miles of an urban area. Atomic bs containing a larger quantity of ac- material but still weighing less than ton may be expected to be available in ten years which could destroy over square miles of a city. A nation able ssign 10 tons of atomic explosives for eak attack on this country, can then to achieve the destruction of all in- ry and most of the population in an from 500 square miles upwards. If hoice of targets, with a total area of hundred square miles of American itory, contains a large enough fraction he nation's industry and population to e their destruction a crippling blow he nation's war potential and its abil- to defend itself, then the attack will pay, and may not be undertaken. At ent, one could easily select in this try a hundred areas of five square s each whose simultaneous destruction ld be a staggering blow to the nation. e the area of the United States is t three million square miles, it should ossible to scatter its industrial and an resources in such a way as to leave 00 square miles important enough to e as a target for nuclear attack.

e are fully aware of the staggering culties involved in such a radical ge in the social and economic struc- of our nation. We felt, however, that dilemma had to be stated, to show t kind of alternative methods of pro- ion will have to be considered if no essful international agreement is hed. It must be pointed out that in field we are in a less favorable posi- than nations which are either now e diffusely populated and whose in- ries are more scattered, or whose governments have unlimited power over the movement of population and the location of industrial plants.

If no efficient international agreement is achieved, the race for nuclear armaments will be on in earnest not later than the morning after our first demonstration of the existence of nuclear weapons. After this, it might take other nations three or four years to overcome our present head start, and eight or ten years to draw even with us if we continue to do intensive work in this field. This might be all the time we would have to bring about the relocation of our population and industry. Obviously, no time should be lost in inaugurating a study of this problem by experts.

III. Prospects of Agreement

The consequences of nuclear warfare, and the type of measures which would have to be taken to protect a country from total destruction by nuclear bombing, must be as abhorrent to other nations as to the United States. England, France, and the smaller nations of the European continent, with their congeries of people and industries, would be in a particularly desperate situation in the face of such a threat. Russia and China are the only great nations at present which could survive a nuclear attack. However, even though these countries may value human life less than the peoples of Western Europe and America, and even though Russia, in particular, has an immense space over which its vital industries could be dispersed and a government which can order this dispersion the day it is convinced that such a measure is necessary—there is no doubt that Russia, too, will shudder at the possibility of a sudden disintegration of Moscow and Leningrad, almost miraculously preserved in the present war, and of its new industrial cities in the Urals and Siberia. Therefore, only lack of mutual trust, and not lack of desire for agreement, can stand in the path of an efficient agreement for the prevention of nuclear warfare. The achievement of such an agreement will thus essentially depend on the integrity of intentions and readiness to sacrifice the necessary fraction of one's own sovereignty, by all the parties to the agreement.

* * *

One possible way to introduce nuclear weapons to one world—which may particularly appeal to those who consider nuclear bombs primarily as a secret weapon developed to help win the present war—is to use them without warning on appropriately selected objects in Japan.

Although important tactical results undoubtedly can be achieved by a sudden introduction of nuclear weapons, we nevertheless think that the question of the use of the very first available atomic bombs in the Japanese war should be weighed very carefully, not only by military authorities, but by the highest political leadership of this country.

Russia, and even allied countries which bear less mistrust of our ways and intentions, as well as neutral countries may be deeply shocked by this step. It may be very difficult to persuade the world that a nation which was capable of secretly preparing and suddenly releasing a new weapon, as indiscriminate as the rocket bomb and a thousand times more destructive, is to be trusted in its proclaimed desire of having such weapons abolished by international agreement. We have large accumulations of poison gas, but do not use them, and recent polls have shown that public opinion in this country would disapprove of such a use even if it would accelerate the winning of the Far Eastern war. It is true that some irrational element in mass psychology makes gas poisoning more revolting than blasting by explosives, even though gas warfare is in no way more "inhuman" than the war of bombs and bullets. Nevertheless, it is not at all certain that American public opinion, if it could be enlightened as to the effect of atomic explosives, would approve of our own country being the first to introduce such an indiscriminate method of wholesale destruction of civilian life.

Thus, from the "optimistic" point of view—looking forward to an international agreement on the prevention of nuclear warfare—the military advantages and the saving of American lives achieved by the sudden use of atomic bombs against Japan may be outweighed by the ensuing loss of confidence and by a wave of horror and repulsion sweeping over the rest of the world and perhaps even dividing public opinion at home.

From this point of view, a demonstration of the new weapon might best be made, before the eyes of representatives of all the United Nations, on the desert or a barren island. The best possible atmosphere for the achievement of an international agreement could be achieved if America could say to the world, "You see what sort of a weapon we had but did not use. We are ready to renounce its use in the future if other nations join us in this renunciation and agree to the establishment of an efficient international control."

After such a demonstration the weapon might perhaps be used against Japan if the sanction of the United Nations (and of public opinion at home) were obtained, perhaps after a preliminary ultimatum to Japan to surrender or at least to evacuate certain regions as an alternative to their total destruction. This may sound fantastic, but in nuclear weapons we have something entirely new in order of magnitude of destructive power, and if we want

to capitalize fully on the advantage their possession gives us, we must use new and imaginative methods.

* * *

It must be stressed that if one takes the pessimistic point of view and discounts the possibility of an effective international control over nuclear weapons at the present time, then the advisability of an early use of nuclear bombs against Japan becomes even more doubtful—quite independently of any humanitarian considerations. If an international agreement is not concluded immediately after the first demonstration, this will mean a flying start toward an unlimited armaments race. If this race is inevitable, we have every reason to delay its beginning as long as possible in order to increase our head start still further.

* * *

The benefit to the nation, and the saving of American lives in the future, achieved by renouncing an early demonstration of nuclear bombs and letting the other nations come into the race only reluctantly, on the basis of guesswork and without definite knowledge that the "thing does work," may far outweigh the advantages to be gained by the immediate use of the first and comparatively inefficient bombs in the war against Japan. On the other hand, it may be argued that without an early demonstration it may prove difficult to obtain adequate support for further intensive development of nucleonics in this country and that thus the time gained by the postponement of an open armaments race will not be properly used. Furthermore one may suggest that other nations are now, or will soon be, not entirely unaware of our present achievements, and that consequently the postponement of a demonstration may serve no useful purpose as far as the avoidance of an armaments race is concerned, and may only create additional mistrust, thus worsening rather than improving the chances of an ultimate accord on the international control of nuclear explosives.

Thus, if the prospects of an agreement will be considered poor in the immediate future, the pros and cons of an early revelation of our possession of nuclear weapons to the world—not only by their actual use against Japan, but also by a prearranged demonstration—must be carefully weighed by the supreme political and military leadership of the country, and the decision should not be left to the considerations of military tactics alone.

One may point out that scientists themselves have initiated the development of this "secret weapon" and it is therefore strange that they should be reluctant to try it out on the enemy as soon as it is available. The answer to this question was given above—the compelling reason for creating this weapon with such speed was our fear that Germany had the technical skill necessary to develop such a weapon, and that the German government had no moral restraints regarding its use.

Another argument which could be quoted in favor of using atomic bombs as soon as they are available is that so much taxpayers' money has been invested in these Projects that the Congress and the American public will demand a return for their money. The attitude of American public opinion, mentioned earlier, in the matter of the use of poison gas against Japan, shows that one can expect the American public to understand that it is sometimes desirable to keep a weapon in readiness for use only in extreme emergency; and as soon as the potentialities of nuclear weapons are revealed to the American people, one can be sure that they will support all attempts to make the use of such weapons impossible.

Once this is achieved, the large installations and the accumulation of explosive material at present earmarked for potential military use will become available for important peace-time developments, including power production, large engineering undertakings, and mass production of radioactive materials. In this way, the money spent on wartime development of nucleonics may become a boon for the peacetime development of national economy.

IV. Methods of International Control

We now consider the question of how an effective international control of nuclear armaments can be achieved. This is a difficult problem, but we think it soluble. It requires study by statesmen and international lawyers, and we can offer only some preliminary suggestions for such a study.

Given mutual trust and willingness on all sides to give up a certain part of their sovereign rights, by admitting international control of certain phases of national economy, the control could be exercised (alternatively or simultaneously) on two different levels.

The first and perhaps simplest way is to ration the raw materials—primarily, the uranium ores. Production of nuclear explosives begins with the processing of large quantities of uranium in large isotope separation plants or huge production piles. The amounts of ore taken out of the ground at different locations could be controlled by resident agents of the international Control Board, and each nation could be allotted only an amount which would make large scale separation of fissionable isotopes impossible.

Such a limitation would have the drawback of making impossible also the development of nuclear power for peace-time purposes. However, it need not prevent the production of radioactive elements o
a scale sufficient to revolutionize the i
dustrial, scientific and technical use
these materials, and would thus not eli
inate the main benefits which nucleoni
promises to bring to mankind.

An agreement on a higher level, invol
ing more mutual trust and understandin
would be to allow unlimited productio
but keep exact bookkeeping on the fate
each pound of uranium mined. If in th
way, check is kept on the conversion
uranium and thorium ore into pure fissio
able materials, the question arises as
how to prevent accumulation of lar
quantities of such materials in the han
of one or several nations. Accumulatio
of this kind could be rapidly convert
into atomic bombs if a nation should bre
away from international control. It h
been suggested that a compulsory denatu
ation of pure fissionable isotopes may
agreed upon—by diluting them, after pr
duction, with suitable isotopes to ma
them useless for military purposes, wh
retaining their usefulness for power e
gines.

* * *

One thing is clear: any internation
agreement on prevention of nuclear arm
ments must be backed by actual and e
cient controls. No paper agreement c
be sufficient since neither this or any oth
nation can stake its whole existence
trust in other nations' signatures. Eve
attempt to impede the international co
trol agencies would have to be conside
equivalent to denunciation of the agr
ment.

It hardly needs stressing that we
scientists believe that any systems
control envisaged should leave as mu
freedom for the peacetime development
nucleonics as is consistent with the saf
of the world.

Summary

The development of nuclear power n
only constitutes an important addition
the technological and military power
the United States, but also creates gra
political and economic problems for t
future of this country.

Nuclear bombs cannot possibly rema
a "secret weapon" at the exclusive dispo
of this country for more than a few yea
The scientific facts on which their co
struction is based are well known to s
entists of other countries. Unless an eff
tive international control of nuclear
plosives is instituted, a race for nucle
armaments is certain to ensue followi
the first revelation of our possession
nuclear weapons to the world. Within t
years other countries may have nucle
bombs, each of which, weighing less th
a ton, could destroy an urban area of mo
than ten square miles. In the war to whi
such an armaments race is likely to le
the United States, with its agglomerati

(Continued on last page)

rance and Atomic Energy . . . . *Frederic Joliot*

ientific discoveries are the raw ma-
l of human progress. Since modern
s, scientific research has been a com-
patrimony at the disposal of scholars
technicians. This common property
ted a solidarity throughout the world
kept going a spirit of international
ual help. Each seeker after knowledge,
tever his particularity may be, con-
tly benefits from discoveries made in
y part of the world. If thirty people
he highest intelligence working to-
er on one problem are suddenly split
each one is reduced to a third, or rather
ould say, to a 3/100 part of his effi-
cy.

or myself I realize that I have only
able to achieve certain results thanks,
instance, to Rutherford, Niels Bohr
Hahn, not to mention my French col-
ues, to English, American, and Italian
ntists etc. I acknowledge my debt of
itude to them and am only too happy
my work has enabled certain English
merican research workers to progress
g a path which I was lucky enough
pen to them.

ANCE, A PIONEER
NUCLEONICS

rance can legitimately claim the knowl-
of the secrets of Atomic Energy
use she is the country which has given
to and developed Nuclear Physics.
a century has passed since Henri
querel and the Curies set off on the
which has led to the present discov-
s and their tradition, just as their
arches have since then been carried on
our country without interruption.
nce was one of the first in the libera-
of Nuclear Energy, and it was not
the events of 1940 that our work
interrupted after which it was carried
n England. French research workers,
Halban, Kowarski, Gueron, Gold-
midt, left France at that time to put
r knowledge of this subject at the
ice of the Allies.

he French must be called upon to par-
ate in the International Commission
the Control of Nuclear Energy, com-
d of scientific experts. This Commis-
, at each step of progress in the re-
ch, could indicate its possible danger-
applications, and make all arrange-
ts to neutralize them. The control of
luction of Nuclear Energy is possible,
use the production would require fac-
s covering an enormous area which
ld naturally not pass unseen. If the
ber of machines used is known, it
ld be easy to calculate the amount of
erial they could turn out. Such knowl-
would avoid monopoly of raw ma-
l, in itself a source of conflict. The
ntists will obviously come to the con-
ion that it is necessary to have international exchange and to suppress monopolies, whether it is a question of new radioactive products or new raw materials; plastics, textiles, etc. The story of petrol deposits confirms this outlook.

THE CONSEQUENCES OF SECRECY

I consider as very dangerous, as I have already said, the position taken up by the United States during recent talks, because keeping the secrets of the atomic bomb appears as a means of pressure. What is serious is that it should henceforth be admitted by certain people that it is possible to keep secret results obtained by scientific research in the field of Nuclear Science. It would thereafter be impossible to visit laboratories of our specialty, to keep going normal relationship with colleagues who are friends and with whom we have for so long collaborated over distances and frontiers.

It is true that for a long time we have been accustomed to industrialists keeping to themselves their technical secrets and methods of manufacture, but it is the first time that the free diffusion of the results of pure science has been forbidden. This principle of secrecy once accepted, there is no reason why it should not be extended to all fields of science. Chemistry, electricity, medicine, biology, even astronomy lead to discoveries which affect the condition of man and can be applied in a decisive manner to economics of war. If secrecy is extended to these sciences, the progress of civilization will be slowed down and may even be halted. We count on the Union of Scientists in every country to militate against the maintenance of secrets and to obtain a wide divulgation of the discoveries.

For he who says civilization says communication. If our species has become the human species, it is doubtless because we have a fairly large brain and hands, but above all because we have been able to create language which enables men to communicate with one another other than by gestures and grimace. The stagnation of civilization at certain periods seems to me due to the isolation of men in small groups. It is significant that in the Middle Ages, the best spreaders of civilization were the Troubadours, who made the different groups have contact with one another. The Renaissance is particularly the establishment of a vast circulation of thought among men. Is it desirable now to stop this circulation, this universal language, by decree? This would take us back to Merovingian times.

Continued secrecy would result in a race for scientific armaments. Each Nation would think that its rival was outdistancing it and would want to catch up. Nuclear Energy would no longer be the servant of civilization but only its destroyer. If the impossible happened and two great powers found themselves to be the sole possessors of the monopoly of this secret arm, other countries in self defense would hasten to discover and use more secret and terrible terrible arms, and above all more treacherous.

THE "SECRET WAR"

With the development of these secret arms, war could become so secret that man would know nothing of its start. Yesterday there was indeed no declaration of war, but the noise of the battle left no one in doubt that a conflict had broken out. But in the future, a country feeling secure through having in its possession a hundred atomic bombs would one day be warned by its statisticians: "for five years now" they will say, "the number of abortions in the central districts has grown to such proportions that there is not one normal birth in six; in the coastal ports fires are destroying the harvests, the drought in the North has deprived the country of a quarter of its electrical energy." Official Headquarters and parliamentarians will pore over these figures, make graphs and will find one explanation only of these multiple catastrophies; for several years war has been waged against their country with immense destruction and a considerable number of victims. And yet no one had known that hostilities had broken out. The enemy at that moment might already have obtained decisive victories and the country conquered without having fought. All that would be left to it would be to capitulate, to destroy the stock of atomic bombs on which it had blindly relied for its security and which will have proved as much an illusion as a line of concrete in 1940.

The day when the world realizes the possibilities of a secret war of this kind is the day when the people will start living in a perpetual state of siege. Facts prove that this ultra secret war is possible because it is already sporadically carried out by certain services who are defending monopolies. A country prospects for raw material essential to it. With any pretext at hand we then see the colony where the riches are found, claim its independence and revolt. If nevertheless the country succeeds in keeping the control of the riches which it has discovered, it is threatened with a famine of other raw material, the importation of which is indispensable.

As far as we are concerned, in spite of this regrettable secret, it is possible for French Scientists and technicians, and that will be the aim of the "Commissariat de l'Energie Atomique," to construct machines for the purpose of producing new radio-active elements and to liberate atom-

Atomic Bomb Damage - Japan and USA

. . . . . *R. E. Marshak, E. C. Nelson, L. I. Schif*

The photographs and descriptions of Hiroshima and Nagasaki after atomic bombardment are now familiar to everyone. But the full horror of the destruction has not yet been shown in pictures or described in words. It is hard to portray the effects that heat and gamma rays (which are nuclear X-rays) had on people. The fires that raged unchecked for days after the explosions were not photographed from the ground. The pictures of steel-frame buildings that still stand and appear to be only slightly harmed do not show the wrecked partitions and furniture or the remains of the people who were inside. Finally, it is hard to visualize the paralysis of nearly all fire-fighting and medical services. Many injured persons died in fires because there were no first-aid facilities left to help them.

To realize what an atomic bomb of the present type could do to an American city, one must first look at the ways in which it produces damage. Then the Japanese experience must be translated from Hiroshima and Nagasaki to a typical American city. Only in this way will it be possible to get some understanding of what an atomic bomb attack would mean to us if another war were ever to come.

FACTORS CONTRIBUTING TO DAMAGE

Four factors contribute to the destruction wrought by an atomic bomb. First, there is the blast, which is mainly responsible for wrecking buildings. Second, there is the enormous heat of the exploding bomb, which by itself can give people fatal burns and even set fire to flimsy structures. Third, there are the gamma rays given off at the instant of the explosion, which inflict a lingering death on people who are too close to the bomb. Finally, particularly if the bomb is exploded close to the ground, there may be radioactive materials left around as a by-product. These produce other gamma rays and may last for days or months afterward. In the two combat "drops" on Japanese cities, the bombs were exploded high in the air and the radioactive materials were dissipated by the wind.

It is worth looking at these four factors in more detail. As we do this, the careful studies that have been made of the damage produced in Hiroshima and Nagasaki will be used as a basis. The test shot in New Mexico also supplied a great deal of information on atomic bomb damage. However, the smaller height at which this bomb was detonated and the absence of buildings make these data less significant.

DESTRUCTION BY THE BLAST

The blast is the familiar concussion that results from ordinary explosions, but enormously magnified. At Hiroshima it wrecked ordinary wooden buildings out to a distance of one and a half miles, corresponding to an area of destruction of seven square miles. At Nagasaki the destruction distance was somewhat greater and would have corresponded to ten square miles if there had been that much city to be destroyed. Since the part of Nagasaki that was attacked was a long, narrow strip lying in a valley, the city area destroyed was somewhat smaller than at Hiroshima —about three square miles. The other seven square miles affected were outside the city limits. The largest demolition bomb previously used—the block-buster—contained two tons of TNT and had a destruction radius for ordinary wooden buildings of about five hundred feet (two city blocks). This gives a destroyed area of one thirty-fifth of a square mile—one three-hundred-and-fiftieth of that to be expected from a Nagasaki-type atomic bomb. This does not mean, however, that an atomic bomb is equivalent to only 350 block-busters. For the inaccuracies in bombing are so great that approximately three times this number of block-busters would have to be dropped in order to destroy ten contiguous square miles. Many of the bombs would overlap, and there would be significant undestroyed gaps. It follows, then, that one Nagasaki-type atomic bomb is equivalent to at least 1,000 block-busters in concentrated effect.

What is the blast from an atomic bomb like? First there is a strong shock wave that pushes very hard on any obstacle in its path for a very short time. This is followed at once by a great wind blowing out from the bomb—a super-hurricane that lasts about a second. The shock wave does most of its damage on large walls that face the bomb blast, collapsing ordinary buildings and stripping facings from steel-frame structures. The blast wind sweeps interior partitions and furniture out of the stronger buildings, snaps trees, bends metal poles, and carries away lighter objects such as street cars and small houses. General results in the two Japanese cities were as follows. The shock wave and the blast wind together demolished brick and timber buildings for nearly half a mile, and made them almost impossible to repair out to about a mile. Lighter frame buildings were demolished out to a mile and a half. Heavy steel-frame buildings appeared to be only slightly damaged from the outside if they were more than a quarter of a mile from t
center of the bomb. But their insides we
swept clean and in some cases the floo
were collapsed, if they were within a mi
and a half of the explosion. The flyi
debris inside these stronger structur
killed or seriously injured all inhabitan
In Nagasaki, the Mitsubishi Steel Pla
was nearly a mile from the bomb. A
though most of the steel frame of t
building remained standing, flying fra
ments of iron and machinery caused clo
to 100 per cent fatalities.

HEAT FROM THE BOMB

The enormous heat produced by
atomic bomb has no true counterpart
ordinary explosions. An ordinary bon
will not kill anyone by heat who wou
not have been killed by blast. Even if
were possible to set off 20,000 tons of TN
in one place, the heat would not be
important source of damage. Even at
distance of several miles, the heat giv
off by an atomic bomb is many times
intense as that from the sun on the hotte
summer day. It will scorch wood a mi
away and ignite flimsy materials at shor
er distances. While some fires were star
ed in this way in the two Japanese "drops
most of them were caused, as in ordina
bombing raids with high explosives,
the collapse of inflammable buildin
around stoves and furnaces. The ultr
violet light accompanying the heat in
atomic bomb explosion is like that pa
of the sun's light which causes sunbur
only much more intense. The heat a
ultra-violet light together have a great
effect on people than on buildings.
Japan, people within several hundr
yards of the bomb were charred blac
while those more than a mile away r
ceived a severe "sunburn." Many perso
who were far enough away from the bon
to survive were later found to have a lig
unburned area—the "shadow" of a no
or an ear—across a heavily "sunburne
face.

A new feature of the atomic bomb
comparison with ordinary bombs is t
fact that it gives off gamma rays, whi
affect people like a violent overdose
X-rays. The more delicate parts of t
body, particularly the tissues that ma
the blood, are badly damaged. The blo
loses its power to coagulate, and oozes i
to the flesh and even through the unbro
en skin. The white blood corpuscles, who
job it is to fight infection, are killed a
their replacement is inhibited. Becau
of this, in the two bombings of Japan pra
tically all persons within half a mile
the center of explosion died later, eve
if they were shielded from the heat a
not hurt by falling timbers and ev

From Atomic Energy for the Layman, a forthcoming publication of the University of New Mexico Press. Printed by permission of the authors and publishers.

gh they appeared immediately after explosion to have been uninjured. y of those farther from the explosion received severe skin burns or were y flying debris did not recover as exd. The gamma rays had so lowered resistance to infection that eventualey died, even from minor injuries.

e radioactive materials produced by two combat bombs—such materials not present in ordinary explosions— dissipated by the wind. The bombs deliberately exploded at a height enough to make sure that this would en. Consistent with the dissipation e radioactive materials, the bomb is set to go off at such a height that argest possible area is covered by a strong enough to wreck ordinary ings. Within limits, the higher the is when it goes off, the greater the covered by the blast, but the smaller blast effect directly under the bomb. mbatant of the future might, howchoose to set the bomb off on or close e ground. This would make the area oyed by blast smaller, but would poimuch of the region with radioactive ances. The wind would not clear away, and they would settle on the nd. Gamma rays would then be presin dangerous amounts for weeks or hs afterwards. This would hamper e work and make the region uninhabe for some time.

the two Japanese cities no deaths due to radioactive substances remainn the area after the explosion. The number of deaths in Hiroshima from other three factors, including fires ed by heat and blast, is estimated to been between 100,000 and 150,000. Nagasaki the deaths are believed to numbered from 20,000 to 50,000.

hat, then, could an atomic bomb of ent type do to an American city? American cities would appear to sufess than the Japanese cities did, bee they are more strongly built. More ings would remain standing, and fewould be completely eradicated by fire. the interior damage would be about same, and there is little reason to bethat there would be fewer people d. Furthermore, the open structure apanese buildings made them less vulble to blast than American buildings their smaller window space would be. us now attempt to describe what would en if an atomic bomb were ever to be ped on a typical American city.

veryone within half a mile of the exon would be killed. Many of those to one and a half miles would be killed combination of direct heat from the b, fire, injuries from falling buildings flying debris, and gamma rays. Light e buildings would be demolished for more than a mile around. Conventional brick houses would be wrecked for at least half a mile. Heavy steel-frame buildings, up to a quarter of a mile away, would have their facings stripped off. Most of them up to a mile and a half would be swept clean of windows and furniture, although they might appear only slightly damaged from the outside. The inhabitants would be killed or seriously injured by flying objects or by the collapse of floors. Openwork structures like bridges or trestles would stand the blast quite well. But for nearly a mile around, any trains or automobiles that happened to be on such structures would be blown off. Some underground systems such as subway tunnels, gas and water mains, and sewage drains would be collapsed directly beneath the bomb. Overhead electric and telephone lines would be broken.

The dead would number many tens of thousands. Casualties would result mainly from the collapse of light buildings and from flying fragments in heavier buildings together with burns and gamma-ray injuries to the blood. The enormous number of casualties would mean that among them large numbers of key personnel—doctors, fire-fighters, police, and civic leaders—would be rendered ineffective, thus hampering rescue work. This situation was especially striking at Hiroshima. The mass destruction of equipment and services as presently distributed in cities —fire trucks, hospitals, water mains, electric and telephone lines—would paralyze even a city only partly destroyed by the bomb. The care of the casualties would tax the facilities of neighboring large cities for hundreds of miles around.

All this from only one bomb. Although damage estimates based on the two Japanese cities may, as remarked before, exaggerate the effects on an American city, the use of larger numbers of bombs would more than cancel out the advantage than an American city has in being more strongly built. Atomic bombs can be made by the thousands, and no country is likely to launch an attack unless it has many bombs that can be devoted to each target city. Furthermore, it is certain that bombs can be made that will be much more powerful than those used against Japan. At least ten times the energy release might be achieved simply by assembling larger amounts of uranium 235 or plutonium. One or two such "improved" bombs would probably suffice to knock any city in the world out of action for weeks, even if the city were not completely destroyed. If there is ever to be a war involving the use of atomic bombs it would certainly be catastrophic.

France and Atomic Energy . . . . . Cont.

(Continued from page five)

ic energy for beneficial purposes. The atomic bomb represents but one of the applications of nuclear energy.

These machines supplying energy will enable important quantities of radio-active elements to be made, the application of which will be of the greatest use for industry and certain successes in biology and medicine. One can even foresee pacific applications of this bomb. It could doubtless be used to transform the surface of large portions of the earth, or to make clouds and to bring down rain over huge areas. We know even now that one day we shall be able to modify contour and climate; it may be that before too many years have gone by we shall be able to do this, at least we are glimpsing hitherto unthinkable possibilities. New radio elements are going to allow chemistry at a very high temperature.

It is certain that our capacity for industrial production does not equal that of other big nations in quantity, but our support cannot be overlooked. The same may happen with nuclear energy as has happened with aviation; we are not at the moment able to build flying fortresses in thousands, but we can make prototypes, undertake the building of planes equalling and sometimes surpassing the qualities of those of the big industrial nations.

We will work as much as is necessary to bring, within the scope of our country, our contribution to the industrial and scientific development which will enable man to progress and to know a better state. If the secrecy is maintained, that will not prevent us from pushing forward with our work and arriving at results which are certainly very honourable and very profitable. A nation can only justify its independence by exporting its achievements and by the blossoming of its thought. We are working to this end and France will bring to the world its share, the share by which it justifies its existence. We are optimists. We are certain that men will not allow progress to be shackled by a monopolization of thought.

An address delivered at the London Conference on Science and the Welfare of Mankind. The speeches of A. V. Hill and P. M. S. Blackett presented at this conference were printed in previous issues of the **Bulletin.**

Russia and the State Department Report . . .

. . . . Maj. G. F. Eliot

The plan for the international control of atomic energy, prepared by the State Department's Board of Consultants as "a basis for discussion," will certainly be widely attacked as supporting the policy of "give away." Yet there is virtue in the board's observation that its proposals should be examined in the light of the alternative.

At first glance, there appears to be one insuperable objection to the plan. The use of such terms as "title," "possession," "ownership," "licensing," implies the existence of a body of known and accepted law under which these terms can have a meaning common to all parties to the agreement.

Such a body of law does not presently exist as between the Soviet Union and the United States or other western nations. International law itself, even in the western world, is vague and uncertain enough; but it might be possible to set up certain principles which could be commonly accepted both by those nations which draw their legal precedents from the English common law and those whose legal origins are in the Roman-Dutch tradition.

In our relations with the Russians, however, we have not even reached the point where we can write down a simple agreement on paper and have it mean the same thing to the Russians as it does to us. The trouble lies in interpretation. No human foresight can provide against every contingency.

There must be certain commonly accepted standards—that is, processes and precedents for interpretation. Every lawyer knows how much depends on these precedents, and how little on the written words of the statute.

For the United States to enter into any such agreement as is proposed by the distinguished members of the State Department's Board of Consultants, we would have to be very sure that all other participants had reached with us a common understanding as to how the agreement was to be applied—an agreement upon principles of law and of procedure.

In this respect, our current experience with the Russians, in respect of the United Nations Charter and such agreements as those of Yalta and Potsdam, is not encouraging. There will be a tendency to say that we cannot possibly consider the creation of an Atomic Development Authority with such wide powers as is now proposed, simply because we have no basis for common understanding with the Russians as to how to make it work. There will be a tendency to point out that our troubles with the Russians have rarely been in the matter of reaching agreements, but almost always when it comes to carrying out agreements in the terms which we thought had been agreed to but which the Russians interpreted in a different way.

Yet if we and the Russians both accept the necessity for international control of atomic energy, as the only alternative to a disaster which would be visited on them as well as on us, the Russians cannot fail to perceive the parallel necessity for finding a workable means of exercising such control.

If they accept the present plan as a basis for discussion—which is all it claims to be—then they cannot help seeing that something more will be needed to make it work than a scrawled signature and a pretty seal at the foot of a neatly printed document.

The very necessity which will be imposed upon the Russian leaders of thinking through the implications of the proposal will bring home to them the fact that they can never hope to establish workable collaboration with the western world altogether on their own terms. There will be much in this proposal that they will not like, that will even seem to them abhorrent. Yet they too must read what is proposed in the cold and awful light of the alternative.

It would be even more abhorrent to the Russians to have the United States, Great Britain and Canada continue, as they are now, the sole proprietors of atomic power and atomic weapons. In fact, from the Russian point of view we may assume this to be unthinkable.

The alternative, then, is for the Russians to do the best they can to catch up, to overtake and surpass the western powers in these field of endeavor. This means, to put it bluntly, an atomic armaments race. It can have only one end. Do the Russians really think this is their best bet? One must doubt it, for they cannot desire the inevitable outcome of such a process. The only remaining and acceptable possibility is some sort of international control.

It will, in any case, be a long time, perhaps several years, before the proposed Atomic Development Authority could be ready to begin its labors. If the Russians accept this plan, or any workable and acceptable plan for international atomic control, they must begin to think in terms of making it work and of convincing others that they can be reliable participants in making it work.

Thus the very consideration of the present atomic proposal may bring about the beginning of the means to carry it into execution. Far from rejecting it out of hand because the basis for interpreti[ng] and applying it does not exist, we sho[uld] rather consider it as a documentation [of] an international necessity so urgent up[on] all peoples that its very expression [in] words must inspire all thinking men [to] seek for and to provide ways in which [it] can be converted into reality.

UN Atomic Commission Almost Complete

The twelve-member United Natio[ns] Atomic Energy Commission has not y[et] met because several member nations ha[ve] delayed the designation of their represe[n]tatives. With the announcement, on Ap[ril] 30, of the appointment of A. Gromyko [as] representative of USSR, the Commissi[on] which is made up of the nations which a[re] members of the Security Council pl[us] Canada, is almost complete, although t[he] representatives of Mexico and Brazil r[e]main to be announced.

The announced appointments are: Un[it]ed States, Bernard M. Baruch; Unit[ed] Kingdom, Sir Alexander Cadogan, w[ith] Professor James Chadwick, alterna[te;] USSR, Andrej Gromyko; France, Alexa[n]dre Parodi, with Frederic Joliot Cur[ie,] alternate; the Netherlands, Dr. Eelco [N.] van Kleffens; Canada, Gen. A. G. L. M[c]Naughton; Australia, Lieut. Col. W. [R.] Hodgson; China, Dr. Quo Tai-chi; Egy[pt,] Dr. Hafez Afifi Pasha; and Poland, P[ro]fessor Stefan Piénkowski, with And[rzej] Soltan, alternate. One delegate (Piénko[w]ski) and three alternates (Chadwick, Jo[li]ot, Soltan) are scientists; the others a[re] diplomats and civilian or military pub[lic] officials.

Applied Science Restricted In Germany

The Allied Control Council on April [..] approved a law providing for a rigid a[nd] continuing control of scientific resea[rch] in Germany. The study of applied nucl[ear] physics is one of nine subjects forbid[den] to all and any Germans.

Also prohibited is research in appl[ied] aerodynamics, rocket propulsion, jet [pro]pulsion, gas turbine engines, radar, und[er]water sounding devices, electric cod[ing] and decoding equipment, ship design a[nd] the remote control of aircraft.

The law encompasses all universiti[es,] colleges, technical high schools, Kai[ser] Wilhelm institutes and industrial-resea[rch] establishments. In addition, the law [re]quires that all research and technical p[er]sonnel shall be registered with the zo[ne] commanders.

hysics and Politics

. . . . *Charles E. Merriam*

1869 Walter Bagehot wrote an in- sting volume entitled, "Physics and ics." Today we look again at this , but in a new and blinding light. atomic bomb is an index of dynamic revolutionary changes, the end of h is not in sight, and which I do not the temerity to forecast. We are ronted by a revolution dimming in ing all human revolutions rolled one.

e meaning of atomic energies is wholly misunderstood. The real el is not that these vast forces exist, that they are found and harnessed he human mind. The mind is king, the atom. We trapped the atom; we mastered some secrets of its latent s, not by accident, but by deliberate n, by organization and ingenuity. nay marvel at the display of physical , but the deeper force of mind made triumph possible, and will bring still ter triumphs as we move along gh eras of discovery and invention. atomic bomb is a symbol of death destruction; but it may also be a ol of life, of construction, of a ger- l principle which will create new con- s for mankind with science and or- zation as the guides to human goals ppiness and freedom long dimly seen. ay that Modern Man is obsolete is nteresting literary phrase, but the se opposite is true. Modern Man s of age.

is, of course, possible that the atomic ies now unleashed in the form of tomic bomb may prove to be uncon- ble under modern conditions, and we may have come to the end of H. G. Wells has called a "cosmic de," relegating the world and all dwell therein to dissolution and re- ation in the whirling universe of we are a part. This I cannot dis- , but I prefer to take the other hesis that man can and will control orces he has set in motion through xercise of reason and science.

LD GOVERNMENT AND RIGHTS OF MAN

this new era, there is little prospect rvival unless we can eliminate vio- as a means of settling disagree- , and establish peace through a order of the world. This is a task ich the students of government may a large and significant contribu- provided they "have what it takes ancestors."

g before the atomic bomb fell, it lear that the emerging character- istics of political association were not primarily territorial or ethnic. They are cultural, fraternal and human. The indi- cations drawn from historical trends, from careful analysis, from reflection and religion alike point to larger areas of authority circling the globe, to kin- ship expanding beyond race to the broth- erhood of man. Machiavelli discussed the relation of fear and love as directions of behavior. In this case, they join forces.

But in what directions and in what manner shall we advance? I begin not with structure, but first ask, "What is it that men have in common in this World Community?" We build around and upon what the World has in common. This calls for a new analysis and declaration of the common rights of man. Included here are the civil rights and political liberties long recognized in theory. We add in modern times, freedom of communication of words and images throughout the world. We add freedom of scientific re- search, and the dissemination of the re- sults of inquiry. Men were not long suc- cessful in blocking Galileo or Darwin. We cannot exclude at this point the greatest of scientific discoveries in our age.

But there may be vast production of goods and services without a large share of justice and freedom in the society. It is consequently one of the problems of politics to examine the conditions and satisfactions of wants and their relation to freedom and justice. Otherwise the world may become a whirling mechanism of fantastic power and speed, directed toward other than general and public ends—a world peopled chiefly by robots who produce incredible results for ends they neither understand nor approve. And the cry may once again arise, was it for this mankind came into the world?

Our common civil and political rights in the technical and constitutional sense alone will leave liberty a mockery, unless they are reenforced by the framework of conditions in which rights may take root and grow and flower. We have in common the need for freedom from fear and want, for guarantees of employment, education, health, housing, recreation and cultural advantages. In broadest form, this means a fair share in the growing gains of civil- ization. Economic structure, class struc- ture, racial structures, national structures may give the lie to words piously uttered, unless the dignity of man is translated into freedom and equality. This, too, is a challenge to the constructive ability of the technicians of government in times to come, when old energies long latent have been newly released and applied to man's needs; in a sense, the challenge of chal- lenges. Doubtless the U.N.—the Economic and Social Council, the Commission on Human Rights—will meet this problem in the near future. Let us hope that they rise to the height of this great occasion in framing a flaming declaration of the rights of man.

At the threshold of the atomic era we encounter new and very difficult prob- lems. Far greater concentrations of power than ever before known are on the way, in fact at the door.

How shall the consent of the governed, the basic principle of democracy, be or- ganized and operated under these condi- tions? Even the time-honored principle of subordination of the military to the civil power is already threatened, even in the home of democracy.

I raise my voice to warn that unless the greatest care is taken and the sound- est judgment dominant, human liberty may be lost at the close of a war for freedom; — lost in the toils of concen- trated dictatorship such as has never been seen before.

Already we find that the regime of fear may stand in the way of full use of atomic energies, for alleged reasons of military necessity and security. Even now the full realization of scientific possibil- ities for human welfare is threatened — from the fear that military secrets may be used for industrial purposes, because they are so closely intertwined. This might be called an unconditional surren- der to fear.

Many types of structural association are needed to compose the demand for a jural order of the world. Of course, we require a world court for the considera- tion and decision of justiciable questions and for arbitration and like forms of friendly offices.

We need a world council for such com- mon purposes as may be agreed upon in the interest of the common good, look- ing to the ends of security, order, justice, welfare and freedom; the protection and development of basic common human rights. I am not discussing here the com- position, organization, power and proce- dures of such a body. Of paramount im- portance is the setting up of an assembly looking at the recognized common good with a view to utilizing the common wis- dom, the common will and common sense of participation in policy. I assume that we will build on the foundation of the U.N. eventually.

SELF GOVERNMENT

World government is not the death of self government, but its new birth and

an address given before the American Po- Science Association on March 29.

life. When the necessity for military self defense in the physical sense has disappeared, many associations will be in a position to flower and flourish as never before — labor, agriculture, industry, educational, scientific, cultural groups, may all proliferate as never before. What shall be their respective spheres of autonomy, of self-government in the best sense of the term? Here is an opportunity for the richest development of cultural autonomy the world has ever seen.

Unquestionably many new forms of affiliations, adherences and adumbrations will spring up around the Economic and Social Council, and especially about the new UNESCO. All sorts of supporting associations and even individuals will gather around the UN, puzzling the astute diplomats and the subtle jurists, but finding a solid basis of community of interests. There may well develop new forms of citizenship with new content and implications in a new period.

The place of the national state, now the most powerful association in the world, will be subject to constant reconsideration and to readjustment with varying views and insitutions of world order. How shall world authority be adjusted to the symbolism and the sovereignty of national authorities? The historic precedents of federalism and of direct jurisdiction of the central authority without regard to intervening authorities will doubtless be — in fact have already been —raised; but these older analogies may not be found sufficiently elastic or inventive to meet the new demands of the new and far more complex social forces and institutions.

PEACE-TIME DEVELOPMENT

A basic common need in a world community is that of systematic energetic planning for the expansion of income and the development of resources, human and natural, everywhere — planning that will release productive energies, enlarge production and bring rising living standards for all men everywhere. Those who scoffed at planning, safe in their own well cushioned security, will be forgotten except as examples of prescientific doubt and drift.

One of the implications of atomic energies is that we must be prepared to reckon with fundamental changes in the basic factors of our social-industrial system. We do not yet know how rapidly it will be possible to harness the new found energies to our system of production, distribution and consumption. Many estimators, I must say, seem as timid as the atomic bombers were bold. Some seem even frightened about proceeding with nuclear energies and would fold their hands awhile. But we are on notice that within the not too distant future, revolutionary changes will be made in this area. We will be obliged to consider not alone the organization of work, but also the organization of leisure time — the problem of recreational and cultural developments for millions of workers. Once the basic essential of a job, of food, of shelter, of education, of medicine are satisfied, what new type of social pattern emerges? Production, employment, stabilization, enterprise, profit, incentives, the balances between goods, services and leisure must be reconsidered in the light of new forces unleashed and attached to new machines. The proletariat tends to disappear, or if you choose to put it that way, the proletariat is all inclusive, and no longer a mark of differentiation.

Even before the atomic age this movement was well under way. The bomb, I reiterate, is only a symbol of vast changes going on in the rise and application of human intelligence to the world around us. The social pressures and controls involved in hunger, disease, poverty, want, were already on their way out, but the process has been accelerated many fold not only in physics, but also in chemistry, in biology, in medicine.

The last war cost hundreds of billions —difficult to calculate, since the effort and sacrifice transcend money values. How much could we afford to spend for peacetime uses of atomic energies? There is grave danger that we may find ourselves as ill-prepared for peace as we were for war; that the flood of new goods and services will overwhelm us with its variety and force. We must be prepared not only for military demobilization, but for the rapid reconversion of old time agencies, traditions, institutions, to the newer forms and functions required by the new times.

It cannot be too strongly stated that the driving motive need not be the fear of death, but the hope of life—richer and finer life than mankind has ever known —life more abundant. Even before the novelty of the roar and surge of the new power has died down, we can then prepare for the utilization of the fantastic wealth of forces available for the satisfactions of the wants of man.

SKILLS

What are the implications of the atomic age for the skills and organs of government?—the adjudicative, the conciliar, the administrative and managerial? With or without world government, these must be carefully sifted through in the approaching time. How will the ends of government, justice, order, welfare, freedom be realized through these agencies as time goes on—full speed ahead?

I do not know the institutional answers to these problems; nor can I predict what a book on government will look like say 20 years from now. But I do know that many of the institutions of our day must go into the crucible—to come out in wh[...] form I cannot know.

What will be their performance in [...] world of new energies and new releas[...] of human activities? We know that cour[...] function best in static periods; we kn[...] that legislative bodies struggle hard [...] deduce policies without being either a[...] bitrary and petty on the one hand, or t[...] rubber-stamp of experts on the oth[...] Management, if it can escape the occup[...] tional disease known as bureaucracy, h[...] less difficulty in close relationships wi[...] technicians and scientists.

In any case there is certain to emer[...] a vast body of research, organized in o[...] form or another—research foundation[...] scientific councils or otherwise, publ[...] private and mixed. Some have suggest[...] science as a fourth branch of governme[...] This is improbable and undesirable, b[...] it appears beyond doubt that resear[...] will develop on a scale hitherto unknow[...] and that the results of research w[...] point more and more precisely to lin[...] of action. Undoubtedly the new Nation[...] Research Foundation will make an i[...] portant contribution to the growth [...] science in all its main aspects, physi[...] and social alike.

How can we tap the intelligence, [...] will, the psychic energies of men to m[...] the new demands of leaders and m[...] alike—for one cannot function without [...] other. More than ever before the cataly[...] agency of politics will be essential [...] the full functioning of social forces [...] the framework of society. If we rem[...] complacent, we may find ourselves [...] much out of the picture as those w[...] were dazed and stunned by bombs.

Politics of the atomic age must ra[...] its sights and expand its skills and te[...] niques to meet the new situations [...] they sweep down upon us. This is a ch[...] lenge to the flexibility, the resource[...] ness, the creative quality, the invent[...] ness of politics.

The politics of the swords cannot s[...] the new problems; nor the backroom [...] itics of the spoils system in its m[...] forms; nor the politics of arroga[...] dressed in a little brief authority. [...] new day is a challenge to the politics [...] intelligence; to reason and science; [...] generative and regenerative abilities; [...] faith in the future; to vision; indomita[...] resolution; unconquerable persistence [...]

It is at this point that physics and [...] itics meet, and meeting need never p[...] marching along together toward t[...] common goal. This is one world, and [...] universe as well. I know we need t[...] and I am convinced that they need [...] and will welcome a hand.

The world is not likely to become, h[...] ever, a vast hospital with the doc[...] assuming control alongside frie[...] nurses or other administrative assist[...]

a passion for anonymity shall we Or a camp, a factory or a laboratory.

S OF GOVERNMENT

know that the ends of government ecurity, order, justice, welfare, free- What effect will the new order have these goals of the political? If we ne, as I do, that the atomic bomb utlaw war, not alone on paper, but ng fact, the end of military security political problem will tend to decline ven disappear. If there are no armed es, the elaborate apparatus designed e military state has no significance ends to drop away.

violent functions of government tend to shrivel away, both on the scene and locally, although not to pear. It would then be necessary hink the ends of government in the of the new situation, and endeavor line the remaining functions of the l—and perhaps the order of their ties—still a matter for political tication and action.

he atomic age it would appear that e, using the term to designate in a r fashion, the production of a great f human utilities and services, would ly loom large as one of the objec- of government as well indeed as society.

duction of goods and services when laced upon a higher level of insight telligence and when freed from the ion of exploitation which has so long the footsteps of production, will possible far-reaching advances to- the attainment of human potential- Government need not be the one com- producer, but will certainly con- tself with the apparatus and con- of production and with the gen- d just diffusion of products through- e community. Liberty and justice om larger than before.

OF POLITICS

nay be hastily concluded that the f politics in the atomic age will be than ever before. This does not however. In the short run there e many expansions of governmental y in many different directions. But long run this may not be true, and it is not impossible that govern- as such may play a more modest an now. We need not forget that ment has few friends. The com- s have always talked about the ing away of the state; the rugged ualists look upon government as ssary evil at best; the church has looked down upon the state as rk of the devil primarily; science s government as ignorant and per- obstructive. At the very moment he state seems to be in full com- its vaunted powers may shrivel le, unless it can rise to the heights new configurations demanded by the new times.

Undoubtedly many new forms of reciprocal adjustments will be set up in the new environment before us, in the establishment of world order, of industrial equilibrium, of basic standards of existence, of human rights, of adequate accountability for new elements of power in the community. Communism and capitalism, Marx and Mill, do not exhaust the vocabulary or the theoretical and practical possibilities of science, political, economic or otherwise, natural or unnatural. The whole purpose of strategic controls and either socialization or decentralization should be the higher form of coordination; the emancipation and release of human energies for fuller freedom.

Politics may thus be said to have a double task in the new age. On the one hand of expanding its functions to bring about basic enterprise, equilibrium and accountability; and on the other hand of demobilizing its own control as rapidly as possible, once the primary objective has been reached, as soldiers are at one time freely expendable and at another rapidly deployable.

To those of the older generation who may think all this is chimerical, I may say that the younger generation understands more quickly the meaning of physical problems than their elders, and may be found to fit with surprising readiness into the needs of the new day for insight, speed and execution. I often find conversation with atomic scientists very refreshing. They may not have experience in politics, but they have courage, vision, and are not frightened by bugaboos.

We need more intimate cooperation with the atomic scientists who are looking for more light in political relations. Our needs are mutual and there are great possibilities in joint action. Many of the atomic scientists have "got religion" so to speak—a sense of social responsibility for what they do; and if they get politics likewise, the world is on its way; or if we meet half-way the technicians in government, the result may prove to be not only exciting, but enlightening.

I suggest the organization of an American Committee on Atomic Energy.

Such a committee might come together for the purpose of considering the broad underlying problems raised by the new developments in atomic energy and its practical applications to human affairs, and for taking such action as seems appropriate from time to time.

Such a Committee might include scientists and technicians from such organizations as the National Research Council, the AAAS., the Social Science Research Council, the Atomic Scientists, and perhaps others.

We need wider spread to all men everywhere of what is now known to political technicians, and this through the multifarious agencies of communication and education now available.

We need the recruitment of far larger personnel and far greater resources for the pursuit of new political truth and its practical applications. Our present facilities are pitifully inadequate to cope with the gigantic task that lies before us. The pages of the Political Science Directory are very thin when compared with the long lists of trained chemists and physicists—far thinner when the list of those who devote the major part of their time to new truth is reckoned.

Finally, if all this seems too professional in character, I submit a few proposals or projects for systematic study in an era of the closer union of physics and politics:

I. A new look at human freedom:

An analysis of the ways and means of preserving freedom and the consent of the governed in the atomic age.

II. Deliberate and systematic planning through as serious an effort as in war, to apply atomic and related energies to peacetime purposes—to increase the gains of civilization, while guaranteeing a fair share of these gains to all men everywhere.

III. Analysis of the organization of a World Community and a World Government, and mapping the roads, theoretical and practical, leading thereto.

I do not have the time or the strength to enter, explore and build up the new and promised land of physics and politics. Evolution points a peaceful way to the new environment we might enter and develop, but the movement will be revolutionary in thought, if not in deed.

League of Women Voters Puts Atomic Energy First

The question of the control of atomic energy took precedence over all other considerations at the 17th convention of the League of Women Voters of the United States, held on May 2 at Kansas City. The delegates, voting on an agenda for league study and support, stressed "public control of atomic energy under civilian agency to insure full development in the public interest and full conformity with international agreement."

The wives of three of the atomic physicists who worked on the Manhattan project—Mrs. Allen C. G. Mitchell, Bloomington, Ind., Mrs. Henry De Wolf Smyth, Princeton, N. J., and Mrs. T. R. Hogness, Chicago, attended the convention as delegates or national board members.

The atomic control item was part of the "active list" agenda adopted by the convention. The "active list" is a program defining the areas for special consideration during the next two years.

International Bureau of Nuclear Standards . . . . G. Sacher

The authors of the State Department's **Report on the International Control of Atomic Energy** emphasize that the early disclosure of information is essential for the establishment of international controls. The report further states (page 56) that "Without much delay (the Atomic Development Authority) should set up laboratories for the study of nuclear physics and the technological problems that it must expect to encounter in its future work."

In the **Draft for a Convention on the Control of Atomic Energy** (Bulletin v. 1 No. 8) by Professor Quincy Wright, provision is made (Art. V, par. 26) for the formation of a Bureau of Nuclear Studies to be created as early as possible.

These authorities evidently consider the formation of an international laboratory to be an important step in achieving effective international control. The following (written before the issuance of the State Department Report) is an attempt to spell out some of the activities of such a laboratory, and the importance of these activities for the success of international controls of nuclear energy. We will refer to the laboratory as the International Bureau of Nuclear Standards.

The essential duties of this Bureau would be the following:

1. Establishment and continual revision of definitions, nomenclature, and symbolism for the constants of the nuclear sciences, with especial attention to the avoidance of ambiguities in translation.
2. Promulgation of standard values of the constants of the nuclear sciences based on measurements made within the Bureau by the best accepted procedures.
3. Setting of standards of purity and strength for materials employed in nuclear energy installations which enter into international trade.
4. (a) Sampling and testing of all materials entering into the construction of specific plants, and (b) official measurements of samples of fissionable materials or other materials collected in the course of inspection.
5. Publication, in official bulletins, of the best practices in design and operation of nuclear energy installations, with especial attention to (a) maximum accessibility for inspection, (b) minimum ease of conversion to bomb plants, (c) maximum efficiency as power units and (d) safety.
6. Evaluation of designs submitted with application for license, and recommendations to a licensing board, with respect to criteria mentioned in (5).

Sufficient justification for all the above functions of an International Bureau of Standards, and for others not stated here, may be found in the historical fact that in every area of scientific and commercial interchange, such regulatory functions have been found necessary. Where the interchange is international, international agreements are ultimately made, as in the case of the physical units. The same necessity is found for agreements on operational practices in such world-wide industries as aviation and the merchant marine.

Still more important is the necessity for unequivocal agreements and standards as the basis for inspection procedures. Without these, the attempt to enforce international control could degenerate into a babel of accusations and denials. Let us suppose that a critical stage in control procedure is that of predicting the output of plutonium to be expected from power piles, and comparing this with the actual amounts declared by the operating agency. Any deficit of the declared from the predicted amount would have to be accounted for by the operators, and an unsatisfactory explanation would be tantamount to a violation of the control agreements. In these circumstances, the inspection authority would need to be in a very strong position, since otherwise the suspected nation could dispute the charge by saying that the discrepancy was due to pecularities of design, materials, or operation not taken into account in the estimates by the inspection authority. The inspection authority could not be its own arbiter in these matters, but would have to rely on an independent bureau of standards with world-wide prestige and authority. This bureau would have made complete determinations of all the data necessary for the estimation of performance, perhaps under circumstances which would preclude any knowledge of the ownership or ultimate use of the materials tested. Thus one large area of dispute could be removed.

The burden of responsibility for effective control procedures will rest entirely on the international control authority. A nation which could evade some phase of control by means of superior knowledge might well consider itself justified in doing so, and presumably could not be brought to task for evasion as long as it conformed to the letter of the control regulations. Therefore, the international control authority would have to keep itself abreast of the latest developments in nuclear physics and technology. Since the strength of the Bureau of Standards [...] its scientific personnel, there must be [...] centives to accept appointments; in[...] ing the provision of large research in[...] lations under direct jurisdiction of [...] Atomic Energy Commission and the g[...] of broad powers to the Bureau so [...] each nation would be interested in b[...] represented by its best men.

So far we have considered the l[...] range necessity for the Bureau; but t[...] is a very pressing immediate problem. [...] international scientific bureau shoul[...] one of the first bureaus to be put int[...] eration by the UNO Atomic Energy [...] mission. Its first duty should be to [...] lect, by independent research if neces[...] the information needed by the other [...] reaus working to set up controls. [...] alternative is that in the formative st[...] each nation will be represented by [...] missioners, with scientific advisers [...] can talk to their own commissioners [...] not to the scientists from other natio[...]

An international scientific body ca[...] collecting information and doing rese[...] independently, minimize the harm ca[...] by nations which consider their scie[...] knowledge to be private property. W[...] er this investigatory function shoul[...] carried out by the permanent Burea[...] Standards or by a temporary organiz[...] set up for the purpose is a matter [...] should receive further consideration

Use of Atom Bomb Assailed By Sheen

Msgr. Fulton J. Sheen of Catholic U[...] versity in a sermon on April 7 in St. P[...] rick's Cathedral in New York scored [...] use of the bomb on Hiroshima as an [...] contrary to the moral law and said, "[...] have invited retailiation for that part[...] lar form of violence."

Both obliteration bombing and use of [...] atomic bomb are immoral, Msgr. Sh[...] said, because "they do away with the m[...] al distinction that must be made in ev[...] war—a distinction between civilians [...] the military."

After quoting the Pope's warn[...] against destructive use of atomic ene[...] in an address made at the opening ses[...] of the Pontifical Academy of Science[...] Feb. 21, 1943, Msgr. Sheen said: "It i[...] be noted that the Holy Father not [...] knew about atomic energy and someth[...] of its power, but he also, exercising his [...] fice as Chief Shepherd of the Chu[...] asked the nations of the world never [...] use it destructively. This counsel was [...] taken. This moral voice was unheede[...]

Discussing arguments that use of [...] atomic bomb shortened the war and sa[...] the lives of American fighting men, M[...] Sheen declared: "That was precisely [...] argument Hitler used in bombing [...] land."

omic Energy in the House of Commons. . *Edward A. Shils*

ent debates in the House of Com- have revealed interesting attitudes e part of Members of Parliament f the Government and disclosed some s of British Government activities atomic energy field.

pite the numerous statements by h governmental and parliamentary s on the urgent necessity of the in- ional control of atomic energy, in rst few months after Hiroshima, re- liscussion in the House of Commons ouched only infrequently on the in- ional aspect of atomic energy. When lackburn, Labour M.P. for Birming- Kings Norton, who has become the of the House of Commons' con- e in atomic energy matters, asked rime Minister on April 8th, whether l any statement to make on the Ache- eport, Mr. Attlee said he preferred ke no comment on the subject, prior discussions in the United Nations c Energy Commission, but that the t would be published by His Majes- tationery Office, even though it was n expression of the views of the can Government.

SH RESEARCH PLANS

nestic and economic aspects has en- the attention of the House of Com- to a far greater degree. The coal in Great Britain, which is now at ight, has impressed a number of ers of Parliament with the urgency development of atomic energy for ul uses. Lt. Col. Martin Lindsay, rvatice M. P. for Solihull, on March basing his argument on the expecta- at British coal supplies will be ex- d within 50 years, demanded both he Government explain more fully t is doing in the atomic energy field at it do more than it has hitherto He was supported in these views . Blackburn. Mr. Blackburn criti- he government for the inadequacy expenditures on atomic energy re- which was projected by Prime Min- ttlee to be £ 2,800,000, in contrast ch Mr. Blackburn asserted that an appropriation of £ 30,000,000 was ry to conduct research on an ade- scale. In response to these criti- both the Prime Minister and the er of Supply, Mr. Wilmot, have de- that the atomic energy research m in Great Britain is limited not by al considerations but by the num- trained scientists and material re- available, especially in building uipment. Mr. Wilmot said; "What- e can do, we shall do...We are no time and sparing no effort. We ploying the best brains and prepar- devote as large a sector of the national effort as can be spared to this development, which we regard as of transcending importance...In the new bill presented by the Government on May 2nd, a sum of £ 30,000,000 is presented as a preliminary estimate of the cost of research and production. The Supply Minister described the progress of the Harwell Research Station as follows: "The central planning is in the hands of the Prime Minister and the cabinet, advised by the learned Advisory Committee presided over with great distinction by the right hon. Gentleman, the Member for the Scottish Universities (Sir J. Anderson)...The research establishment which it is proposed to establish at Harwell will be got going a soon as it is physically possible. It will be provided with every possible facility. The airfield was evacuated by the Royal Air Force at the beginning of the year, and work of converting the buildings to their new purposes is already under way. New, highly specialized, buildings will need to be constructed, and a team of experts is at present in Canada preparing plans to incorporate the very latest knowledge ... At the same time we shall press on with the construction plant to produce the fissionable material which the research establishment will require ... The first stage of the work of extensive designing and planning of operations is going forward. A special organization is being established for the purpose. Work is startting. Accommodation for the designing team has been made available at a Ministry of Supply factory at Risley, near Warrington. Engineering and other expert staff is being recruited as quickly as it can be obtained. The examination of sites for the establishment of the main production plant is now going forward, but no decision has yet been made. Meanwhile, the Ministry of Supply factory at Springfields, near Preston, has been selected as the site for the subsidiary plant for the processing of materials. Over and above these direct Government research and production activities, it is the Government's policy to encourage and support, in every way, research at universities and elsewhere on fundamental problems which may, in time, lead to discoveries of prime importance in this new field of nuclear energy."

BRITISH ATOMIC ENERGY BILL

After having been pressed on several occasions to state whether an atomic energy bill, similar to the U. S. McMahon Bill for the control and development of atomic energy, would be introduced into the House of Commons, the Government on May 2nd, announced a bill to place atomic energy research and production under Government control. The Ministry of Supply will have the power to acquire materials plants and contractual rights relating to atomic energy. Operating under civilian control, the Atomic Energy Section of the Ministry of Supply will have powers to inspect any building where there is reason to believe atomic energy research or production are being conducted. First press reports of the bill did not indicate whether inspection would be carried out by existing security agencies or whether the atomic energy office would establish its own. Security provisions apparently prohibit the disclosure of production techniques but will not apply to scientific knowledge.

The Minister of Supply insisted that the bill would be compatible with Britain's full collaboration in an international control scheme. The question as to whether atomic bombs would be produced was left open.

Members of Parliament have also raised questions regarding the seriousness and comprehensiveness of the government's plans for domestic utilization of atomic energy in view of the decision of the Central Electricity Board to spend £300,000,-000 during the next ten years on the supply of electricity and in connection with the new plans of the Board of Trade and the Ministry of Town and Country Planning for the location of industry and the planning of urban settlements. Thus far, the Government has made no reply to these criticisms.

Many questions have been raised about atomic energy control throughout the Empire, since some of the Members believe that atomic energy will be of even greater importance for certain parts of the Commonwealth, like India and Australia, where present fuel sources are insufficient. In response to one of these questions it was disclosed that a continuous survey of the resources of the British Commonwealth and Empire of uranium and thorium has been in operation for an unspecified time.

THORIUM AND URANIUM SUPPLIES

The control of uranium and thorium sources has been repeatedly discussed in the course of which the Government has announced that "steps have already been taken by his Majesty's Government and other Commonwealth and Empire Governments to ensure full control over the disposal of such supplies". It should be noted that Mr. Attlee spoke of control over the disposal of uranium and thorium and not actual acquisition for which Mr. Blackburn has been pressing.

A gap in the Government's program of control over uranium and thorium de-

(Continued on page fifteen)

Chairman of American Chemical Society Calls for International Cooperation of Scientists

Chairman-elect of the ACS, Prof. W. A. Noyes of the University of Rochester, appealed on April 8 at the Atlantic City meeting of the ACS, for free speech for, and international cooperation between scientists:

"Throughout the ages science and politics have never been completely separated.

The first World War saw the scientist raised to a position of importance in national defense which he had never attained before, and the recent world conflict has taken him into politics whether he likes it or not.

But along with the exaltation of the scientist to the role of the person who must be pampered and favored so that he will do his bit for his country, be it right or wrong, there has come the desire to control him and to make him the tool of those forces to which he should show the most aversion.

An inevitable conflict is now bound to arise, and scientists must give careful thought and consideration to their future, or they will find that the very achievements which have brought them to a position of eminence will be the main cause of their downfall. Americans have always believed in free speech and assembly. Are scientists to be subjected to something which is not American and which will, if carried to its logical conclusion, make the practice of science, in the true sense of the word, impossible?

The Army and the Navy both should be expected to perform functions which devolve on the armed services, but military men are not trained as scientists. The only guarantee of progress in science and of peace in the world is an avoidance of laws, applicable to peacetime, which restrict the scientist in discussions with his fellow scientists. He must have the full benefit of the work of others if his talents are to be used to the fullest advantage.

But platitudes of this sort mean little unless they are followed by recommendations for a definite course of action. Can we as Americans afford to give the world the benefits of our scientific endeavor unless we receive similar benefits in return? Probably not yet, but let us follow a course of action which will make reciprocity easy if not inevitable.

The Russians called an international group of scientists together last June even before the end of the war with Japan. Let us call international scientific congresses to be held in this country at an early date. Let us bring in the scientists of all countries, small and select groups at first, perhaps, but in any case let us pay expenses if no other means can be found. Above all let any of our own scientists attend regardless of whether they worked on atomic bombs or other top secret projects. Let us show that we trust our scientists and let the world know that we believe progress and happiness depend on a free interchange of information and ideas. Scientists do have a common language and they can sit around the table in amicable discussion. Perhaps their example could alleviate some of the distrust so prevalent today."

Kansas Meetings . . . . by Lyle Bo

A group of six atomic scientists, cooperating with a group of faculty members representing the University of Kansas, has made a systematic tour of Kansas during the first part of April, as an experiment in public education.* The experiment was an unqualified success.

The State of Kansas was divided into regions surrounding eight key cities: Kansas City, Topeka, Salina, Hays, Dodge City, Wichita, Chanute, and Pittsburg. In each city a group of about 200 representatives of local and regional organizations met to discuss the problems before the United States and the world, made urgent by the advent of the atomic bomb.

Each conference opened with a morning session devoted to the realities of atomic energy. A panel of four atomic scientists discused the fundamental facts and their consequences; that we may expect no enduring monopoly of the atomic bomb, that there is no defense, that other nations can do what we have done in 3 to 5 years, and that the control of the bomb must be accomplished on a world level.

The afternoon session began with the showing of films of the Alamogordo test and the Nagasaki strike. A description was given by Dr. Jorgensen of Los Alamos, of his impression of an atomic explosion. The panel at this meeting consisted of University of Kansas faculty members and scientists. Possible peacetime application and the economic implications of atomic energy were described. The remainder of the session was devoted to the problems of international and domestic control with great emphasis placed upon the Acheson Report as a realistic and feasible approach to their solution.

The evening dinner session was led by a panel of local people and was devoted to a floor discussion of what the people in that community could do. At about half the conferences resolutions were passed with great unanimity, endorsing the principle of international control as embodied in the Acheson Report, and endorsing the principles of the original McMahon Bill. Where resolutions were not proposed, floor discussion showed the same unanimity of opinion expressed at other places by formal resolutions.

The popularity of these conferences great. The response was enthusias and the interest did not lag at any ti The final success of the series, howe cannot easily be determined, for it rest upon how the representatives pres carry the information back to their ganizations and what action is taken these organizations. The conferences ceived excellent coverage by the local pers, and in many cases half hour r broadcasts were given by the visiting entists.

The idea for the systematic coverag Kansas came to Dr. Hilden Gibson, fessor of Political Science and Sociol at the University of Kansas, after att ing a conference on atomic energy at University of Denver at which unive ties of western and mountain states represented. Chancellor Walott of University of Kansas, agreed that su program fell within the established cies of the University of Kansas. The cess of the venture must be attribute the diligence of Dr. Gibson and the ad able ground work laid by Mr. Lee G mell of the Extension Division of the versity.

The method of developing such a se is worthy of description. A request sent from the Extension Division to superintendent of schools at each city ing him to form a local committee to with Mr. Gemmell to lay plans. At of these meetings the idea and pur of the conference was explained. The committee was requested to submit a of names of leading citizens and repre tatives of local organizations to whon vitations would be sent. The local mittees made arrangements for a pla hold the conference and other details.

The scientists present at various st were: H. S. Brown, L. B. Borst, P. S. shaw from Oak Ridge, Tenn.; D. L. J. J. Nickson, from Chicago; Theodore gensen from Los Alamos. Members o University of Kansas faculty were: Allen, Director of Government Rese R. A. Brewster, Chair. Dept. of Chemi H. B. Chubb, Dept. of Political Sci Lee Gemmell, University Extension sion, Hilden Gibson, Dept. of Political ence and Sociology, R. S. Howey, De Economics, D. M. Hume, Dept. of Ch try, (formerly of Oak Ridge, Tenn), Ire, Department of Economics, J. A. loney, Director of Research Founda L. J. Pritchard, Dept. of Economics, Sandelins, Chairman, Dept. of Pol Science, E. O. Steve, Dept. of Politica ence, J. D. Stranathan, Chairman, of Physics, L. L. Waters, Dept. of nomics.

A short report on this tour was given in B No. 9.

NCE AND RESEARCH IN THE
RATED COUNTRIES

J. A. Simpson

London, I met Dr. Holbrook Mac-
e. He has been the liaison officer in
on for the Office of Scientific Research
Development, which closed recently.
zing that there is still a great service
performed in scientific liaison with
in and the liberated countries, Dr.
Nielle accepted a similar position with
Navy Bureau of Research and Inven-

pointed out, as I later found out my-
that the scientists on the Continent
rope lack the most elementary equip-
and supplies. The British scientists
lready helping as much as they can
rrect this situation. Because of the
nt financial difficulties in England
liberated Europe the scientists are
llowed to purchase goods from the
d States.

is important to remember that
SCO will formulate the long range
am in this field and that scientists
the countries will depend upon it
heavily. In a discussion with Dr.
Huxley, I learned that quite an ex-
e program for the interchange of
ists and scientific information will
dertaken by UNESCO. He believes,
ample, that such things as electronic
ating machines should be located in
gic parts of the civilized world for
e of scientific groups and that many
hes of a microfilming center should
tributed throughout the world. The
am, however, is one which will take
l years to place in effective opera-
At the present time, the Preparatory
ission for UNESCO (on which Mrs.
en Brunauer is the USA represen-
) is in no effective position to help
ists in the liberated countries.

re are a few possibilities for helping
nulate science in the liberated coun-
immediately:

t might be possible to open an ac-
in the United States for foreign
ists to use in ordering books and
nent. This procedure would permit
duals to receive the equipment or
that they need. Such a program
have to be sponsored by a founda-

f scientific journals are still not be-
eceived by foreign countries, we
provide a fund for purchasing back
and current issues of journals in
ca and arrange with some existing
ution system to distribute the jour-
o specified foreign universities and
sts.

Jnited States scientific and technical
liaison officers could be stationed in the European area and China. American scientists could make substantial contributions to our nation as well as to the other nations by spending a year in such areas. Dr. MacNielle pointed out that several U.S. scientists, through his office, should visit all European laboratories to determine the conditions for research which exist at present. The British Commonwealth Scientific Office in the U.S., China and elsewhere has proved invaluable for all nations concerned. The French Scientific Mission in London is equally valuable.

is a continuation of Dr. Simpson's note on
to London. (See **Bulletin** Vol. 1, No. 8)

Atomic Energy in the House of Commons . Cont.

(Continued from page thirteen)

posits was exposed by Mr. Blackburn with respect to the ownership of the extensive thorium deposits in Travancore, India, which are the largest deposits of thorium in the world. Mr. Henderson, Under-Secretary of State for India, announced on March 18th, that the deposits "are the property of the State of Travancore. Adequate steps to control their disposal have been taken by the State Authorities in consultation with the Crown Representatives". Mr. Henderson did not reply to a question as to whether the Government should not have acquired the deposits previously, nor did he seem to show awareness of a fact disclosed on the 28th of March by Mr. Blackburn, that the Travancore deposits are being worked on a concession held by a company, apparently British, called Hopkin and Williams (Travancore) Limited, in which a substantial interest is held by Imperial Chemical Industries which should of course facilitate the Government's control over these deposits.

AMERICAN SECRETIVENESS

Critics, impatient with the Government's policy, have discharged some of their resentment against the United States, saying that part of the reason for the backwardness of Britain's atomic energy development at present is due to the ungenerous secretiveness of the American Government which has refused to divulge information regarding the production of plutonium or the details of the construction of the type of atomic bomb used against Hiroshima.

On March 28th, Mr. Blackburn said: "British scientists know all the details made of uranium 235. We do not know—and it has been made clear by the Prime Minister's answer to a previous question—of the construction of the atomic bomb the details of the construction of an atomic bomb made from plutonium. The Nagasaki bomb was made from plutonium, and was, in fact, about four times as powerful as the uranium 235 bomb which was dropped on Hiroshima. The seriousness of that is this. Of the peaceful development of atomic energy 90 per cent is associated with the plutonium process and only 10 per cent with the separation of uranium 235. British scientists know perfectly well how to construct a bomb made out of uranium 235. Therefore, it is not logical for the United States of America, on the grounds of military security, to refrain from divulging to us information about the plutonium process, because we know how to make a bomb made of uranium 235 ... Therefore, it seems to me to be a most serious matter that the United States of America should be failing to allow our scientists to visit, for instance, Hanford Engineering Works, where plutonium is manufactured, which produced the bomb. As an illustration of how important the plutonium process is as compared with the uranium 235 process, it is from the plutonium process that one is able to extract, in bulk, the radioactive substances and radiations which are of such vital value in medical research and therapy. This is, in some respects, most ungenerous, when one considers that Britain was responsible for almost all the fundamental research on this subject. Our British scientists went over to the United States of America; our British scientists contributed every scrap of knowledge they had on this subject."

* * *

In general, the Government, speaking through Mr. Wilmot, although conceding the claims made for atomic energy's ultimate significance for British economic life, has in its general tone, seemed, at least prior to the introduction of the bill on May 2nd, to deny the validity of these claims. Mr. Wilmot, in his statement of the 28th of March repeatedly asserted that the obstacles in the development of atomic energy for peaceful purposes are still very great and will remain so in the near future, that fuel costs are only a small proportion of the total cost of energy, and that the need for coal will continue undefinitely into the future as far as Great Britain is concerned. A general atmosphere of conservatism and of grudging concessiveness to his critics, pervaded Mr. Wilmot's statement. It is therefore difficult to determine whether the apparent slowness of the Government's prosecution of the atomic energy program is due to the genuinely insuperable difficulties arising from manpower and materials shortages, or whether they are a product of unimaginativeness and unwillingness to entertain the possibility of drastically unconventional solutions of problems in an industry, the problems which socialists have traditionally thought could be solved simply through socialization.

In this issue:

Frederic Joliot—Nobel Prize Laureate in Physics; alternate delegate for France on the UN atomic energy commission.

Charles E. Merriam—Prof. Emeritus of Political Science at the University of Chicago; Past President of the Social Science Research Council and the American Political Science Association.

Profs. Robert E. Marshak, Eldred C. Nelson and **Leonard I. Schiff** are in the physics departments of the University of Rochester, California Institute of Technology and the University of Pennsylvania respectively. During the war, they were members of the staff of the Los Alamos Laboratory, New Mexico.

Lyle B. Borst is a leading nuclear physicist at the Clinton Laboratories, Oak Ridge, Tennessee, and a member of the Executive Committee of the Association of Oak Ridge Scientists.

George Sacher is Associate Biologist and Group Leader on the Metallurgical Project at the University of Chicago.

Edward A. Shils—Ass't Professor of Sociology, University of Chicago; Ass't Director of the Office of Inquiry into the Social and Political Implications of Atomic Energy.

Report to War Dept. . . .

(Continued from page four)

of population and industry in comparatively few metropolitan districts, will be at a disadvantage compared to nations whose population and industry are scattered over large areas.

We believe that these considerations make the use of nuclear bombs for an early unannounced attack against Japan inadvisable. If the United States were to be the first to release this new means of indiscriminate destruction upon mankind, she would sacrifice public support throughout the world, precipitate the race for armaments, and prejudice the possibility of reaching an international agreement on the future control of such weapons.

Much more favorable conditions for the eventual achievement of such an agreement could be created if nuclear bombs were first revealed to the world by a demonstration in an appropriately selected uninhabited area.

In case chances for the establishment of an effective international control of nuclear weapons should have to be considered slight at the present time, then not only the use of these weapons against Japan, but even their early demonstration, may be contrary to the interests of this country. A postponement of such a demonstration will have in this case the advantage of delaying the beginning of the nuclear armaments race as long as possible.

If the government should decide in favor of an early demonstration of nuclear weapons, it will then have the possibility of taking into account the public opinion of this country and of the other nations before deciding whether these weapons should be used against Japan. In this way, other nations may assume a share of responsibility for such a fateful decision.

Council of Federation of American Scientists Meets

The council of the Federation of American Scientists met at the University of Pittsburgh on April 20 and 21. Representatives of 15 organizations with a total paid-up membership of about 2000 scientists (a list of FAmS member organizations is given below) were present. Three new associations—Eastern Iowa, Wisconsin and Cornell University—were admitted to the Federation.

Atomic Energy legislation, general science legislation and the State Department Report were discussed on the first day. Resolutions endorsing the Kilgore-Magnussen bill on National Science Foundation and the Acheson-Lilienthal report were adopted.

On the second day, reports were made on the educational activities of the individual organizations, including the several professional and city-wide conferences organized at Chicago and the state-wide lecture tour in the state of Kansas. It was decided that each group in the Federation should organize at least one conference within the next 6 weeks, or a state-wide undertaking within the next 3 months.

The Cornell Association of Scientists

The Association of Scientists of Cornell University at Ithaca, N.Y. is the most important recent addition to the Federation of American Scientists. The new organization counts among its members some of the prominent "atomic scientists" formerly associated with the Los Alamos atomic bomb laboratory—R. F. Bacher, H. A. Bethe, Phillip Morrison and Richard P. Feynman.

A series of radio programs over station WHCU and a panel discussion on station CRG on the subject of World Control of Atomic Energy have been organized.

Dr. J. R. Oppenheimer is presenting a series of six Messenger lectures at Cornell between April 30 and May 14 on the technical and political problems of atomic energy.

MEMBERS OF FEDERATION OF AMERICAN SCIENTISTS

as of April 9, 1946

Association of Cambridge Scientists, Radiation L[aboratory], M.I.T., Cambridge 39, Mass.

Atomic Scientists of Chicago, 1126 East 59th Str[eet], Chicago, Ill.

Association of Los Alamos Scientists, P.O. Box 16[...], Santa Fe, New Mexico.

Association of New York Scientists, 3280 Broad[way] (until June 15, 1946), New York, N. Y. also: Physics Department, Columbia Univer[sity], New York 27, N. Y.

Association of Oak Ridge Scientists, P. O. Box 1[...], Oak Ridge, Tenn.

Association of Pasadena Scientists, 1201 E. C[ali]fornia St., Pasadena ,Calif.

Rocket Research Group, Allegheny Ballistics Lab[ora]tory, P. O. Box 210, Cumberland, Md.

Oak Ridge Engineers & Scientists, 433 East D[...], Oak Ridge, Tenn.

Dayton Association of Atomic Scientists, 1503 [...] Main Street, Dayton 5, Ohio.

Association of Pittsburgh Scientists, 402 Thaw H[all], University of Pittsburgh, Pittsburgh, Pa.

Association of University of Michigan Scient[ists], Department of Chemistry, University of M[ichi]gan, Ann Arbor, Michigan.

Federation of American Scientists, Rochester A[sso]ciation, Dept. of Botany, Rochester Univer[sity], Rochester, N. Y.

Association of Philadelphia Scientists, Physics D[ept.], University of Pennsylvania, Philadelphia, P[a.]

Northern California Association of Scientists, 2[...] Channing Way, Berkeley 4, Calif.

Association of Eastern Iowa Scientists, 614 S. C[lin]ton, Iowa City, Iowa.

Association of Scientists of Cornell Univer[sity], Rockefeller Hall, Ithaca, N. Y.

Wisconsin Association of Scientists, Dept. of Ph[ysics], University of Wiconsin, Madison 6, Wiscons[in].

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BULLETIN OF THE ATOMIC SCIENTISTS

EDITORS:

H. H. Goldsmith   E. Rabinowitch

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LETIN of the

TOMIC SCIENTISTS

1 MAY 15, 1946 No. 11

DANGEROUS LULL . . .

e atomic energy debate is hanging fire—nationally as well ernationally.

the domestic field, the McMahon bill, a product of months pert testimony, of much heartsearching by statesmen, the ry and scientists, and of extensive and difficult legislative is in peril of being crowded out, from the short remain-ongressional calendar, by subjects such as strikes, draft, price administration — all matters of prime importance the short-time point of view, but dwarfed, in the long run, e greatest problem of our time — the control of nuclear y.

the bill is not passed this session the reconversion of our laboratories and production plants to permanent peace-organization — which alone will end stagnation and give us to long-range fundamental research — will be delayed. Army (which has repeatedly voiced its desire for rapid fer of the atomic energy establishments to civilian control) have to proceed with the planning of peace-time develop-, in which it is unwilling and ill-prepared to engage.

e fight for the civilian control of atomic energy, which een carried — if not to a full success, at least to an accept-ompromise — by the various organizations and individuals d together in the Committees for Civilian Control of ic Energy, is in danger of being lost by default — the lt of Congress to act on a question of transcending na- importance. A concerted effort of all who are aware of is at stake can still prevent this deplorable failure, by g it clear to the congressional leaders that while the Con- might like to forget about atomic energy, the Nation re-ers it and expects action.

* * *

United Nations debate on interna- control of atomic energy is also ng time. The membership list of the ission created by the United Nations en weeks ago in London, has finally completed, but the date of its first g is still uncertain. According to Reston of the Washington staff of ew York Times, "on the urging of l nations, the UN have asked the d States to hold the Commission's meeting in New York on May 27, but ate Department has indicated today 14) that we would ask for another nement."

Reston finds the main explanation delay in the "archaic mechanism" ich foreign policy problems are han- n Washington. It prevents, accord- him, any essential progress from made while the Secretary of State ent from Washington, as Mr. Byrnes een much of the time. "As a result," des Mr. Reston, "many and devious ses are often ascribed by other nations to the United States for delays that spring from simpler reasons. There seems little evidence to support the charges that the United States has purposely shelved the atomic-energy question because it is not really willing to carry this explosive issue into the United Nations."

* * *

While the delay in formulation of the American atomic energy policy is undoubtedly germaine to the general difficulties encountered in the making of foreign policy decisions in American democracy, it is also true that the problem of devising a plan for international control of atomic energy is a novel and extremely difficult one. For the scientists, who have grappled with this problem for two or three years, the proposition that its solution cannot be achieved except by a bold new departure in international affairs, has become trivial; but the same cannot be expected from laymen — be they politicians, economists, lawyers or bankers. When they are called to devise a program, they at first are bound to shy away from propositions which appear too radical and unrealistic, and to try to find solutions of a more conventional character. However, we have seen during the past nine months, that the inescapable "logic of facts" ends in converting most if not all who have studied the problems, from Sauls into Pauls of international control. We need only to compare the early pronouncements of American policy on the atomic bomb with the subsequent Truman-Attlee-King declara tion. We recall the gradual change of mind of the members of the Lilienthal board, so vividly described in their report — the path from scepticism and resignation, to firm belief that a solution can be found, if international cooperation substituted for mutual suspicion and wrangling for national advantages.

* * *

We hope that the same logic of facts will put its imprint also on the "policy paper" which according to political reporters, the American delegation to the UN Atomic Energy Commission, is preparing at present. We do not expect this policy to be necessarily identical in all details with that proposed in the Acheson-Lilienthal report, but we expect it to be equally bold in conception and constructive in its proposals. And beyond this, when the matter actually comes under discussion in the United Nations Commission, we hope that the same inescapable facts will compel the diplomats, from whatever country they might come, to forget the disappointments they have experienced in recent attempts to reach agreement on much more limited and conventional international issues, and to realize that only a radically new, comprehensive and imaginative plan can save their nation — all nations — from the disaster of an atomic war.

In This Issue

Hiroshima—August 6, 1945 . . . . . . *Father Siemes, S. J*

A BRIGHT SUMMER MORNING

Up to August 6th, occasional bombs, which did no great damage, had fallen on Hiroshima. Many cities roundabout, one after the other, were destroyed, but Hiroshima itself remained protected. There were almost daily observation planes over the city but none of them dropped a bomb. The citizens wondered why they alone had remained undisturbed for so long a time. There were fantastic rumors that the enemy had something special in mind for this city, but no one dreamed that the end would come in such a fashion as on the morning of August 6th.

August 6th began in a bright, clear, summer morning. About seven o'clock, there was an air raid alarm which we had heard almost every day and a few planes appeared over the city. No one paid any attention and at about eight o'clock, the all-clear was sounded. I am sitting in my room at the Novitiate of the Society of Jesus in Nagatsuke; during the past half year, the philosophical and theological section of our Mission had been evacuated to this place from Tokyo. The Novitiate is situated approximately two kilometers from Hiroshima, half-way up the sides of a broad valley which stretches from the town at sea level into this mountainous hinterland, and through which courses a river. From my window, I have a wonderful view down the valley to the edge of the city.

A GARISH LIGHT— A MODERATELY LOUD THUD

Suddenly—the time is approximately 8:14—the whole valley is filled by a garish light which resembles the magnesium light used in photography, and I am conscious of a wave of heat. I jump to the window to find out the cause of this remarkable phenomenon, but I see nothing more than that brilliant yellow light. As I make for the door, it doesn't occur to me that the light might have something to do with enemy planes. On the way from the window, I hear a moderately loud explosion which seems to come from a distance and, at the same time, the windows are broken in with a loud crash. There has been an interval of perhaps ten seconds since the flash of light. I am sprayed by fragments of glass. The entire window frame has been forced into the room. I realize now that a bomb has burst and I am under the impression that it exploded directly over our house or in the immediate vicinity.

I am bleeding from cuts about the hands and head. I attempt to get out of the door. It has been forced outwards by the air pressure and has become jammed. I force an opening in the door by means of repeated blows with my hands and feet and come to a broad hallway from which open the various rooms. Everything is in a state of confusion. All windows are broken and all the doors are forced inwards. The book-shelves in the hallway have tumbled down. I do not note a second explosion and the fliers seem to have gone on. Most of my colleagues have been injured by fragments of glass. A few are bleeding but none has been seriously injured. All of us have been fortunate since it is now apparent that the wall of my room opposite the window has been lacerated by long fragments of glass.

We proceed to the front of the house to see where the bomb has landed. There is no evidence, however, of a bomb crater; but the southeast section of the house is very severely damaged. Not a door nor a window remains. The blast of air had penetrated the entire house from the southeast, but the house still stands. It is constructed in a Japanese style with a wooden framework, but has been greatly strengthened by the labor of our Brother Gropper as is frequently done in Japanese homes. Only along the front of the chapel which adjoins the house, three supports have given way (it has been made in the manner of Japanese temple, entirely out of wood.)

THE GHASTLY PROCESSION

Down in the valley, perhaps one kilometer toward the city from us, several peasant homes are on fire and the woods on the opposite side of the valley are aflame. A few of us go over to help control the flames. While we are attempting to put things in order, a storm comes up and it begins to rain. Over the city, clouds of smoke are rising and I hear a few slight explosions. I come to the conclusion that an incendiary bomb with an especially strong explosive action has gone off down in the valley. A few of us saw three planes at great altitude over the city at the time of the explosion. I, myself, saw no aircraft whatsoever.

Perhaps a half-hour after the explosion, a procession of people begins to stream up the valley from the city. The crowd thickens continuously. A few come up the road to our house. We give them first aid and bring them into the chapel, which we have in the meantime cleaned and cleared of wreckage, and put them to rest on the straw mats which constitute the floor of Japanese houses. A few display horrible wounds of the extremities and back. Tl small quantity of fat which we possess during this time of war was soon used in the care of the burns. Father Rekt who, before taking holy orders, had studi medicine, ministers to the injured, b our bandages and drugs are soon gone. V must be content with cleansing the woun

More and more of the injured come to The least injured drag the more seriou wounded. There are wounded soldiers, a mothers carrying burned children in th arms. From the houses of the farmers the valley comes word: "Our houses full of wounded and dying. Can you he at least by taking the worst cases?" T wounded come from the sections at edge of the city. They saw the bright lig their houses collapsed and buried the mates in their rooms. Those that were the open suffered instantaneous bur particularly on the lightly clothed or clothed parts of the body. Numerous fi sprang up which soon consumed the ent district. We now conclude that the epice er of the explosion was at the edge of city near the Jokogawa Station, three ki meters away from us. We are concer about Father Kopp who that same mo ing, went to hold Mass at the Sisters the Poor, who have a home for child at the edge of the city. He had not retur as yet.

Toward noon, our large chapel and brary are filled with the seriously inju The procession of refugees from the continues. Finally, about one o'clock, ther Kopp returns together with the ters. Their house and the entire dist where they live has burned to the grou Father Kopp is bleeding about the h and neck, and he has a large burn on right palm. He was standing in front the nunnery ready to go home. All o sudden, he became aware of the light, the wave of heat and a large blister for on his hand. The windows were torn by the blast. He thought that the b had fallen in his immediate vicinity. nunnery, also a wooden structure made our Brother Gropper, still remained soon it is noted that the house is as g as lost because the fire, which had be at many points in the neighborhood, swe closer and closer, and water is not av able. There is still time to rescue cert things from the house and to bury th in an open spot. Then the house is sw by flame, and they fight their way bac us along the shore of the river and thro the burning streets.

Soon comes news that the entire city been destroyed by the explosion and t it is on fire. What became of Father

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This eyewitness report is reprinted by permission of The Jesuit Mission. The author, the Reverend John A. Siemes, was professor of modern philosophy at Tokyo's Catholic University.

and the three other Fathers who at the center of the city at the Central on and Parish House? We had up to me not given them a thought because d not believe that the effects of the encompassed the entire city. Also, d not want to go into town except pressure of dire necessity, because ought that the population was greatly rbed and that it might take revenge y foreigners which they might con-spiteful onlookers of their misfortune, n spies.

SCUE PARTY RGANIZED

her Stolte and Father Erlinghagen wn to the road which is still full of es and bring in the seriously injured ave sunken by the wayside, to the rary aid station at the village school. iodine is applied to the wounds but re left uncleansed. Neither ointments her therapeutic agents are available. that have been brought in are laid floor and no one can give them any r care. What could one do when all are lacking? Under those circum-s, it is almost useless to bring them nong the passersby, there are many re uninjured. In a purposeless, in-e manner, distraught by the magni-f the disaster most of them rush by one conceives the thought of organiz-lp on his own initiative. They are ned only with the welfare of their milies. It became clear to us during days that the Japanese displayed nitiative, preparedness, and organi-l skill in preparation for catas-s. They failed to carry out any res-rk when something could have been by a cooperative effort, and fatal-y let the catastrophe take its course. we urged them to take part in the work, they did everything willingly, their own initiative they did very

bout four o'clock in the afternoon, logy student and two kindergarten n, who lived at the Parish House joining buildings which had burned came in and said that Father Su-LaSalle and Father Schiffer had eriously injured and that they had refuge in Asano Park on the river It is obvious that we must bring n since they are too weak to come n foot.

riedly, we get together two stretch-l seven of us rush toward the city. Rektor comes along with food and ne. The closer we get to the city, eater is the evidence of destruction e more difficult it is to make our The houses at the edge of the city severely damaged. Many have col-or burned down. Further in, almost all of the dwellings have been damaged by fire. Where the city stood, there is a gigantic burned-out scar. We make our way along the street on the river bank among the burning and smoking ruins. Twice we are forced into the river itself by the heat and smoke at the level of the street.

Frightfully burned people beckon to us. Along the way, there are many dead and dying. On the Misasi Bridge, which leads into the inner city we are met by a long procession of soldiers who have suffered burns. They drag themselves along with the help of staves or are carried by their less severely injured comrades...an endless procession of the unfortunate.

Abandoned on the bridge, there stand with sunken heads a number of horses with large burns on their flanks. On the far side, the cement structure of the local hospital is the only building that remains standing. Its interior, however, has been burned out. It acts as a landmark to guide us on our way.

Finally we reach the entrance of the park. A large proportion of the populace has taken refuge there, but even the trees of the park are on fire in several places. Paths and bridges are blocked by the trunks of fallen trees and are almost impassable. We are told that a high wind, which may well have resulted from the heat of the burning city, has uprooted the large trees. It is now quite dark. Only the fires, which are still raging in some places at a distance, give out a little light.

At the far corner of the park, on the river bank itself, we at last come upon our colleagues. Father Schiffer is on the ground pale as a ghost. He has a deep incised wound behind the ear and has lost so much blood that we are concerned about his chances for survival. The Father Superior has suffered a deep wound of the lower leg. Father Cieslik and Father Kleinsorge have minor injuries but are completely exhausted.

THE CHURCH AND SCHOOL ARE RUINED

While they are eating the food that we have brought along, they tell us of their experiences. They were in their rooms at the Parish House—it was a quarter after eight, exactly the time when we had heard the explosion in Nagatsuke—when came the intense light and immediately thereafter the sound of breaking windows, walls and furniture. They were showered with glass splinters and fragments of wreckage. Father Schiffer was buried beneath a portion of a wall and suffered a severe head injury. The Father Superior received most of the splinters in his back and lower extremity from which he bled copiously. Everything was thrown about in the rooms themselves, but the wooden framework of the house remained intact. The solidity of the structure which was the work of Brother Gropper again shone forth.

They had the same impression that we had in Nagatsuke: that the bomb had burst in their immediate vicinity. The Church, school, and all buildings in the immediate vicinity collapsed at once. Beneath the ruins of the school, the children cried for help. They were freed with great effort. Several others were also rescued from the ruins of nearby dwellings. Even the Father Superior and Father Schiffer despite their wounds, rendered aid to others and lost a great deal of blood in the process.

In the meantime, fires which had begun some distance away are raging even closer, so that it becomes obvious that everything would soon burn down. Several objects are rescued from the Parish House and were buried in a clearing in front of the Church, but certain valuables and necessities which had been kept ready in case of fire could not be found on account of the confusion which had been wrought. It is high time to flee, since the oncoming flames leave almost no way open. Fukai, the secretary of the Mission, is completely out of his mind. He does not want to leave the house and explains that he does not want to survive the destruction of his fatherland. He is completely uninjured. Father Kleinsorge drags him out of the house on his back and he is forcefully carried away.

FLIGHT BY BOAT— WHIRLWINDS AND WATERSPOUTS

Beneath the wreckage of the houses along the way, many have been trapped and they scream to be rescued from the oncoming flames. They must be left to their fate. The way to the place in the city to which one desires to flee is no longer open and one must make for Asano Park. Fukai does not want to go further and remains behind. He has not been heard from since. In the park, we take refuge on the bank of the river. A very violent whirlwind now begins to uproot large trees, and lifts them high into the air. As it reaches the water, a waterspout forms which is approximately 100 meters high. The violence of the storm luckily passes us by. Some distance away, however, where numerous refugees have taken shelter, many are blown into the river. Almost all who are in the vicinity have been injured and have lost relatives who have been pinned under the wreckage or who have been lost sight of during the flight. There is no help for the wounded and some die. No one pays any attention to a dead man lying nearby.

The transportation of our own wounded

is difficult. It is not possible to dress their wounds properly in the darkness, and they bleed again upon slight motion. As we carry them on the shaky litters in the dark over fallen trees of the park, they suffer unbearable pain as the result of the movement, and lose dangerously large quantities of blood. Our rescuing angel in this difficult situation is a Japanese Protestant pastor. He has brought up a boat and offers to take our wounded up stream to a place where progress is easier. First, we lower the litter containing Father Schiffer into the boat and two of us accompany him. We plan to bring the boat back for the Father Superior. The boat returns about one-half hour later and the pastor requests that several of us help in the rescue of two children whom he had seen in the river. We rescue them. They have severe burns. Soon they suffer chills and die in the park.

The Father Superior is conveyed in the boat in the same manner as Father Schiffer. The theology student and myself accompany him. Father Cieslik considers himself strong enough to make his way on foot to Nagatsuke with the rest of us, but Father Kleinsorge cannot walk so far and we leave him behind and promise to come for him and the housekeeper tomorrow. From the other side of the stream comes the whinny of horses who are threatened by the fire. We land on a sand spit which juts out from the shore. It is full of wounded who have taken refuge there. They scream for aid for they are afraid of drowning as the river may rise with the sea, and cover the sand spit. They themselves are too weak to move. However, we must press on and and finally we reach the spot where the group containing Father Schiffer is waiting.

DARKNESS CONCEALS THE HORROR

Here a rescue party had brought a large case of fresh rice cakes but there is no one to distribute them to the numerous wounded that lie all about. We distribute them to those that are nearby and also help ourselves. The wounded call for water and we come to the aid of a few. Cries for help are heard from a distance, but we cannot approach the ruins from which they come. A group of soldiers comes along the road and their officer notices that we speak a strange language. He at once draws his sword, screamingly demands who we are and threatens to cut us down. Father Laures, Jr., seizes his arm and explains that we are German. We finally quiet him down. He thought that we might well be Americans who had parachuted down. Rumors of parachutists were being bandied about the city. The Father Superior who was clothed only in a shirt and trousers, complains of feeling freezing cold, despite the warm summer night and the heat of the burning city. The one man among us who possesses a coat gives it to him and, in addition, I give him my own shirt. To me, it seems more comfortable to be without a shirt in the heat.

In the meantime, it has become midnight. Since there are not enough of us to man both litters with four strong bearers, we determine to remove Father Schiffer first to the outskirts of the city. From there, another group of bearers is to take over to Nagatsuke; the others are to turn back in order to rescue the Father Superior. I am one of the bearers. The theology student goes in front to warn us of the numerous wires, beams and fragments of ruins which block the way and which are impossible to see in the dark. Despite all precautions, our progress is stumbling and our feet get tangled in the wire. Father Kruer falls and carries the litter with him. Father Schiffer becomes half unconscious from the fall and vomits. We pass an injured man who sits all alone among the hot ruins and whom I had seen previously on the way down.

On the Misasa Bridge, we meet Father Tappe and Father Luhmer, who have come to meet us from Nagatsuke. They had dug a family out of the ruins of their collapsed house some fifty meters off the road. The father of the family was already dead. They had dragged out two girls and placed them by the side of the road. Their mother was still trapped under some beams. They had planned to complete the rescue and then to press on to meet us. At the outskirts of the city, we put down the litter and leave two men to wait until those who are to come from Nagatsuke appear. The rest of us turn back to fetch the Father Superior.

Most of the ruins have now burned down. The darkness kindly hides the many forms that lie on the ground. Only occasionally in our quick progress do we hear calls for help. One of us remarks that the remarkable burned smell reminds him of incinerated corpses. The upright, squatting form which we had passed by previously is still there.

Transportation on the litter, which has been constructed out of boards, must be very painful to the Father Superior, whose entire back is full of fragments of glass. In a narrow passage at the edge of town, a car forces us to the edge of the road. The litter bearers on the left side fall into a two meter deep ditch which they could not see in the darkness. Father Superior hides his pain with a dry joke, but the litter which is now no longer in one piece cannot be carried further. We decide to wait until Kinjo can bring a hand cart from Nagatsuke. He soon comes back with one that he has requisitioned from a collapsed house. We place Father Superior on the cart and wheel him the rest of the way, avoid as much as possible the deeper pits in road.

About half past four in the morning, finally arrive at the Novitiate. Our res expedition had taken almost twelve ho Normally, one could go back and fort the city in two hours. Our two woun were now, for the first time, prop dressed. I get two hours sleep on the fl some one else has taken my own bed. T I read a Mass *in gratiarum actionem*, the 7th of August, the anniversary of foundation of our society. Then we be ourselves to bring Father Kleinsorge other acquaintances out of the city.

THE MORNING AFTER—TWO MO EXPEDITIONS TO HIROSHIMA

We take off again with the hand c The bright day now reveals the frigh picture which last night's darkness partly concealed. Where the city s everything, as far as the eye could re is a waste of ashes and ruin. Only sev skeletons of buildings completely bu out in the interior remain. The bank the river are covered with dead wounded, and the rising waters have and there covered some of the corpses. the broad street in the Hakushima dist naked burned cadavers are particul numerous. Among them are the wou who are still alive. A few have cra under the burnt-out autos and tr Frightfully injured forms beckon t and then collapse. An old woman a girl whom she is pulling along with fall down at our feet. We place the our cart and wheel them to the hospit whose entrance a dressing station has set up. Here the wounded lie on the floor, row on row. Only the largest wo are dressed. We convey another so and an old woman to the place bu cannot move everybody who lies expos the sun. It would be endless and it is c tionable whether those whom we can to the dressing station can come out a because even here nothing really effe can be done. Later, we ascertain tha wounded lay for days in the burnt-out ways of the hospital and there they

We must proceed to our goal in the and are forced to leave the wound their fate. We make our way to the where our church stood to dig up few belongings that we had buried ye day. We find them intact. Everything has been completely burned. In the r we find a few molten remnants of vessels. At the park, we load the h keeper and a mother with her two chi on the cart. Father Kleinsorge feels st enough, with the aid of Brother Nobu to make his way home on foot. The back takes us once again past the and wounded in Hakushima. Agai

e parties are in evidence. At the sa Bridge, there still lies the family the Fathers Tappe and Luhmer yesterday rescued from the ruins. A of tin had been placed over them to them from the sun. We cannot take along for our cart is full. We give and those nearby water to drink and to rescue them later. At three o'clock afternoon, we are back in Nagatsuka.

er we have had a few swallows and e food, Fathers Stolte, Luhmer, Erl- gen and myself, take off once again ng in the family. Father Kleinsorge sts that we also rescue two children ad lost their mother and who had lain him in the park. On the way, we greeted by strangers who had noted we were on a mission of mercy and praised our efforts. We now met s of individuals who were carrying ounded about on litters. As we ar- at the Misasa Bridge, the family ad been there was gone. They might have been borne away in the mean- There was a group of soldiers at taking away those that had been ced yesterday.

OCTORS, NO DRUGS— INJURED DIE

e than thirty hours had gone by the first official rescue party had red on the scene. We find both chil- nd take them out of the park: a six- old boy who was uninjured, and a -year old girl who had been burned the head, hands and legs, and who in for thirty hours without care in rk. The left side of her face and the e were completely covered with blood s, so that we thought that she had e eye. When the wound was later d, we noted that the eye was intact at the lids had just become stuck er. On the way home, we took an- group of three refugees with us. first wanted to know, however, of ationality we were. They, too, feared we might be Americans who had uted in. When we arrived in Nagat- it had just become dark.

took under our care fifty refugees d lost everything. The majority of were wounded and not a few had ous burns. Father Rektor treated unds as well as he could with the dicaments that we could, with effort, up. He had to confine himself in to cleansing the wounds of puru- aterial. Even those with the smaller are very weak and all suffered from a. In the farm houses in the vicin- most everywhere, there are also d. Father Rektor made daily rounds ed in the capacity of a painstaking an and was a great Samaritan. Our was, in the eyes of the people, a greater boost for Christianity than all our work during the preceding long years.

Three of the severely burned in our house died within the next few days. Suddenly the pulse and respirations ceased. It is certainly a sign of our good care that so few died. In the official aid stations and hospitals, a good third or half of those that had been brought in died. They lay about there almost without care, and a very high percentage succumbed. Everything was lacking: doctors, assistants, dressings, drugs, etc. In an aid station at a school at a nearby village, a group of soldiers for several days did nothing except to bring in and cremate the dead behind the school.

FUNERAL PROCESSIONS FROM MORNING TO NIGHT

During the next few days, funeral processions passed our house from morning to night, bringing the deceased to a small valley nearby. There, in six places, the dead were burned. People brought their own wood and themselves did the cremation. Father Luhmer and Father Laures found a dead man in a nearby house who had already become bloated and who emitted a frightful odor. They brought him to this valley and incinerated him themselves. Even late at night, the little valley was lit up by the funeral pyres.

We made systematic efforts to trace our acquaintances and the families of the refugees whom we had sheltered. Frequently, after the passage of several weeks, some one was found in a distant village or hospital but of many there was no news, and these were apparently dead. We were lucky to discover the mother of the two children whom we had found in the park and who had been given up for dead. After three weeks, she saw her children once again. In the great joy of the reunion were mingled the tears for those whom we shall not see again.

EVENT SLOWLY PIECED TOGETHER: ONE BLOW DESTROYED WHOLE CITY

The magnitude of the disaster that befell Hiroshima on August 6th was only slowly pieced together in my mind. I lived through the catastrophe and saw it only in flashes, which only gradually were merged to give me a total picture. What actually happened simultaneously in the city as a whole is as follows: As a result of the explosion of the bomb at 8:15, almost the entire city was destroyed at a single blow. Only small outlying districts in the southern and eastern parts of the town escaped complete destruction. The bomb exploded over the center of the city. As a result of the blast, the small Japanese houses in a diameter of five kilometers, which compressed 99% of the city, collapsed or were blown up. Those who were in the houses were buried in the ruins. Those who were in the open sustained burns resulting from contact with the substance or rays emitted by the bomb. Where the substance struck in quantity, fires sprang up. These spread rapidly.

The heat which rose from the center created a whirlwind which was effective in spreading fire throughout the whole city. Those who had been caught beneath the ruins and who could not be freed rapidly, and those who had been caught by the flames, became casualties. As much as six kilometers from the center of the explosion, all houses were damaged and many collapsed and caught fire. Even fifteen kilometers away, windows were broken. It was rumored that the enemy fliers had spread an explosive and incendiary material over the city and then had created the explosion and ignition. A few maintained that they saw the planes drop a parachute which had carried something that exploded at a height of 1,000 meters. The newspapers called the bomb an "atomic bomb" and noted that the force of the blast had resulted from the explosion of uranium atoms, and that gamma rays had been sent out as a result of this, but no one knew anything for certain concerning the nature of the bomb.

How many people were a sacrifice to this bomb? Those who had lived through the catastrophe placed the number of dead at at least 100,000. Hiroshima had a population of 400,000. Official statistics place the number who had died at 70,000 up to September 1st, not counting the missing ... and 130,000 wounded, among them 43,500 severely wounded. Estimates made by ourselves on the basis of groups known to us show that the number of 100,000 dead is not too high. Near us there are two barracks, in each of which forty Korean workers lived. On the day of the explosion, they were laboring on the streets of Hiroshima. Four returned alive to one barracks and sixteen to the other. 600 students of the Protestant girls' school worked in a factory, from which only thirty to forty returned. Most of the peasant families in the neighborhood lost one or more of their members who had worked at factories in the city. Our next door neighbor, Tamura, lost two children and himself suffered a large wound since, as it happened, he had been in the city on that day. The family of our reader suffered two dead, father and son; thus a family of five members suffered at least two losses, counting only the dead and severely wounded. There died the Mayor, the President of the central Japan district, the Commander of the city, a Korean prince who had been stationed in Hiroshima in the capacity of an officer, and many other high ranking officers. Of the professors of the University, thirty-two were killed or severely injured. Especially hard hit

were the soldiers. The Pioneer Regiment was almost entirely wiped out. The barracks were near the center of the explosion.

RADIOACTIVE AFTER-EFFECTS

Thousands of wounded who died later could doubtless have been rescued had they received proper treatment and care, but rescue work in a catastrophe of this magnitude had not been envisioned; since the whole city had been knocked out at a blow, everything which had been prepared for emergency work was lost, and no preparation had been made for rescue work in the outlying districts. Many of the wounded also died because they had been weakened by under-nourishment and consequently lacked in strength to recover. Those who had their normal strength and who received good care slowly healed the burns which had been occasioned by the bomb. There were also cases, however, whose prognosis seemed good who died suddenly. There were also some who had only small external wounds who died within a week or later, after an inflammation of the pharynx and oral cavity had taken place. We thought at first that this was the result of inhalation of the substance of the bomb. Later, a commission established the thesis that gamma rays had been given out at the time of the explosion, following which the internal organs had been injured in a manner resembling that consequent upon Roentgen irradiation. This produces a diminution in the numbers of the white corpuscles.

Only several cases are known to me personally where individuals who did not have external burns later died. Father Kleinsorge and Father Cieslik, who were near the center of the explosion, but who did not suffer burns became quite weak some fourteen days after the explosion. Up to this time small incised wounds had healed normally, but thereafter the wounds which were still unhealed became worse and are to date (in September) still incompletely healed. The attending physician diagnosed it as leucopania. There thus seems to be some truth in the statement that the radiation had some effect on the blood. I am of the opinion, however, that their generally undernourished and weakened condition was partly responsible for these findings. It was noised about that the ruins of the city emitted deadly rays and that workers who went there to aid in the clearing died, and that the central district would be uninhabitable for some time to come. I have my doubts as to whether such talk is true and myself and others who worked in the ruined area for some hours shortly after the explosion suffered no such ill effects.

THE JAPANESE AND THE BOMB

None of us in those days heard a single outburst against the Americans on the part of the Japanese, nor was there any evidence of a vengeful spirit. The Japanese suffered this terrible blow as part of the fortunes of war . . . something to be borne without complaint. During this war, I have noted relatively little hatred toward the allies on the part of the people themselves, although the press has taken occasion to stir up such feelings. After the victories at the beginning of the war, the enemy was rather looked down upon, but when allied offensive gathered momentum and especially after the advent of the majestic B-29's, the technical skill of America became an object of wonder and admiration.

The following anecdote indicates the spirit of the Japanese: A few days after the atomic bombing, the secretary of the University came to us asserting that the Japanese were ready to destroy San Francisco by means of an equally effective bomb. It is dubious that he himself believed what he told us. He merely wanted to impress upon us foreigners that the Japanese were capable of similar discoveries. In his nationalistic pride, he talked himself into believing this. The Japanese also intimated that the principle of the new bomb was a Japanese discovery. It was only lack of raw materials, they said, which prevented its construction. In the meantime, the Germans were said to have carried the discovery to a further stage and were about to initiate such bombing. The Americans were reputed to have learned the secret from the Germans, and they had then brought the bomb to a stage of industrial completion.

* * *

We have discussed among ourselves the ethics of the use of the bomb. Some consider it in the same category as poison gas and were against its use on a civil population. Others were of the view that in total war, as carried on in Japan, there was no difference between civilians and soldiers, and that the bomb itself was an effective force tending to end the bloodshed, warning Japan to surrender and thus to avoid total destruction. It seems logical to me that he who supports total war in principle cannot complain of war against civilians. The crux of the matter is whether total war in its present form is justifiable, even when it serves a just purpose. Does it not have material and spiritual evil as its consequences which far exceed whatever good that might result? When will our moralists give us a clear answer to this question?

PRESIDENT TRUMAN'S SPEECH AT FORDHAM

President Truman spoke at Fordh University in New York on May 11. discussed education in the post-war wo and repeatedly referred to education the main bulwark against a new ato war. He said:

"There is profound truth in the f line of the new charter of the United tions educational, scientific and cult organization. The Charter declares: 'S wars begin in the minds of men, it i the minds of men that the defenses peace must be constructed.'

I fear we are too much concerned material things to remember that our strength lies in spiritual values. I d whether there is in this troubled w today, when nations are divided by jeal and suspicion, a single problem that c not be solved if approached in the s of the Sermon on the Mount.

The new age of atomic energy pre upon us. Mark that well! What may b been sufficient yesterday is not suffic today. New and terrible urgencies, and terrible responsibilities, have placed upon education.

Ignorance and its handmaidens, pr dice, intolerance, suspicion of our fel men, breed dictators. And they breed w Civilization cannot survive an atomic Nothing would be left but a world red to rubble. Gone would be man's hope decency. Gone would be our hope for greatest age in the history of manki an age which you and I know can har atomic energy for the welfare of man not for his destruction."

Later in the speech, he stressed the for universal fellowship, and said:

"That was the last message from P dent Roosevelt. In a speech which he w just before he died, but which he n delivered, he said:

'We are faced with the pre-eminent that, if civilization is to survive, we cultivate the science of human rela ships—the ability of all peoples, o kinds, to live and work together, in same world, at peace.'

Until citizens of American and cit of the other nations of the world this "science of human relationships which President Roosevelt spoke, atomic bomb will remain a frig weapon which threatens to destroy a us.

But there is at least one defense ag this bomb. That defense lies in our tering this science of human relation all over the world. It is the defens tolerance and of understanding, of in gence and thoughtfulness.

When we have learned these thing shall be able to prove that Hiroshima not the end of civilization, but the b ning of a new and better world."

hat About the Bikini Tests? . . . . . . *Lee A. DuBridge*

e projected atomic bomb tests at
i Atoll this summer raise many ques-
which ought to be understood by
American public before the tests oc-
If these questions had been asked
months ago public opinion might
opposed the tests with sufficient force
ave them cancelled. But assuming it
o late for this, there are still many
cts which need to be publicized if
results of the tests are not to create
ss misundersandings, exaggerated
s and general confusion on impor-
issues of national security and world
e. I wish to remark briefly here on
questions: (1) What will be the mili-
value of the tests? (2) What will
e scientific values? (3) What is the
(4) What are the possible impli-
ns?

HE MILITARY VALUE

viously, the air burst and surface
tests planned for this summer will
much data on what such bursts will
ships and to the equipment and
als placed on the ships. No doubt
reds of secret reports will be written
e variation with distance from the
t point of the damage done to masts,
n turrets, to tanks and trucks and
and rabbits and field kitchens. There
e profound discussions of why Ship
s sunk and ship B was not. Extensive
s will go to ship designers to make
stronger, and designers of other
ry equipment will be handed new
ications intended to render materiel
ulnerable to blast and heat. And the
will be assured that in future atom-
rs the U. S. military equipment will
rder to damage than it used to be.

re is of course a certain military
in all this. Empirical data of this
can be more easily understood and
by most people than theoretical cal-
ons. The only questions are whether
data are worth the cost and whether
of the results could not be predicted
information already at hand. It is
wn belief (backed up by opinions
ssed to me by many top experts)
much could be predicted and the
s not worth the cost.

vever, the important point is this:
less of the value of the volumes
pirical data collected, these tests
still unanswered the basic strategic
on of whether navies or armies are
te and how future warfare might
nducted.

pose only two or three ships are
– do we then conclude that the Navy
supreme as our first line of defense
e need not fear atomic warfare?
will draw this conclusion, without
and it will be widely publicized.
he test ignores the basic question of what the strategic mission of the fleet will be in future warfare, or whether the fleet is worth destroying by atomic bombs. If it is, no one doubts that a properly placed atomic bomb can put a battleship or carrier out of action — no matter how much thicker its beams or plates are made. One bomb is 100 or more times less expensive than a capital ship so a fleet can be put out of action if it is worth while. Conversely if many ships should be sunk does this mean we abandon the Navy? Not at all. It has functions which need to be performed regardless of possible danger of loss. This question again will depend on the basic philosophy of warfare which develops — not on the results of these or any other tests. The existence of the atomic bomb itself and its gross effectiveness will affect this philosophy— not the details of blast pressure or radiation intensity, or whether an LST has to be one or two or five miles away to escape damage.

In short, military data will be collected, but basic military questions will not be answered by these tests.

2. THE SCIENTIFIC VALUES

According to officials of Joint Task Force One some 1000 scientists, engineers and technicians are to be engaged in these tests using a magnificent collection of measuring equipment to collect data of all kinds on blast, radiation of all wavelengths, biological effects, temperature and pressure conditions in the blast and a host of other items.

The results — if they should be published, which most of them certainly won't be — would be very interesting. They would not, however, make a ripple on the surface of basic nuclear science. The study of nuclear fission will not be advanced one iota by all these figures. The value to pure science will be nil.

Engineers and ordnance experts and bomb designers will certainly learn something. But wouldn't science and engineering be far better off if the 100 million dollars or so which the tests will cost could be devoted to laboratory research under controlled conditions? I believe even the bomb experts would learn more if this were done. The "scientific" results will have value only to the designer of military equipment — and this problem we have already discussed.

3. THE COST

The cost of the proposed tests is insignificant compared to the cost of a war. And hence with a war just over we are likely to feel the cost is really insignificant. Is it?

Let's forget the cost of the ships which may be sunk — if any are. They are no doubt obsolete anyway.

But the other costs are not negligible — as can be seen if one asks what could be done with 100 million dollars (or whatever it is) in scientific research — or in education aimed toward preventing another war.

Even more important than the dollar cost is the cost in scientific man power. Fortunately most of the top scientists who were engaged in the Manhattan Project during the war are now back at their universities and their efforts are not going into the tests. (Some at least refused to participate because of their grave doubts of the value or propriety of the tests.) Though the value of the tests might have been enhanced had these men participated, it is certainly to the best interests of the country that they are not. But it is said there are 1000 or so technical people participating. Many no doubt look forward to the trip and to seeing the explosion. But the diversion at this time of 1000 technical men — even though most of them are probably technicians rather than scientists and engineers — for from 1 to 6 months is in itself a heavy cost. How the universities need these men now for their overcrowded class rooms and undermanned research staffs!

But there are other possible costs in the form of unforeseen or unavoidable dangers. The enormous and intensely radioactive cloud that rises from an atomic explosion is a terrifying thing. It is completely subject to the whims of meteorology. Who can say that a sudden rain storm could not precipitate dangerous quantities of this material onto one or more of the ships packed with observers? Or might not a cloud of this lethal dust be carried hundreds of miles and deposited on unsuspecting inhabitants? The surface burst will raise a great cloud of water spray and where will it be carried? Who can be sure that a malfunctioning of the bomb or its detonator or release mechanism will not put many men in grievous danger? What if the bomb should plunk into the lagoon without going off at all?

Atomic bombs are not things to be taken lightly. The dangers above mentioned may be remote — but I know of experts who are participating in the tests who are gravely worried about one or more of them. And even if the dangers are not great it is no small thing to project such quantities of radioactive material into the air anyplace on earth. It can travel far. Photographic plates were spoiled by radioactive material from the first bomb which was deposited hundreds of miles away. Appreciable activities have been detected in this country from the two bombs over Japan. These activities

(Continued on page 16)

Science and International Co-operation . . . *E. U. Condo*

INTRODUCTION

We are just emerging from the most destructive war in history, a war which bears the same relation to World War I as full-scale production does to a pilot plant. A large part of Europe lies in ruins, as does much of Asia, and great parts of the world's population are dying of famine. Millions are dead, millions more will yet die, as a direct result of the war's dislocations. And millions more are barely carrying on in an existance close to death. It will take many years merely to restore conditions to the level at which they were before the war. Only then can we go ahead to make a better civilization than the one which came so near to destruction at the hands of the once-powerful Rome-Berlin-Tokyo axis.

Over us hangs an oppressive feeling that the war just passed may have been but the pilot plant operation preliminary to a World War III whose destructiveness will exceed that of II in something like the same ratio as II of I. In fact, those of us who are aware of the technical possibilities, know that a World War III, if it comes to pass, will have a destructiveness of this order. Therefore, this time the only hope of civilization lies in making sure that there shall be no more war.

If we are to have a lasting peace on which to base new levels of human progress, this can only be done through the development of mutual confidence and understanding, between all the peoples of the world, in every field of human activity—economic, social, political, educational, cultural, ethical and scientific. Tonight I want to discuss a little the part of this larger problem which deals with international cooperation in science.

DECLINE OF INTERNATIONAL SCIENCE BEFORE THE WAR

We should begin by being clear about the condition in which science finds itself today. To do this, let us review briefly some general trends observable during the first half of the twentieth century. Before 1941, there was very little organized scientific research in America. Nearly all research was done in the universities and on a much smaller scale than we know it today. None of the major industrial laboratories were in existence except some embryonic beginnings.

Prior to World War I, America had been very definitely a scientific dependency in her relation to European culture. The main stream of progress occurred principally in England, France, and Germany. Americans participated, proudly bringing their contributions to the European stream and eagerly reading the European journals and going abroad to study. Americans imported their science.

During World War I this relationship to Europe was greatly altered, first by the stopping of scientific work in Europe and second by our own participation in the latter part of the struggle. After the war, however, these international contacts were very quickly resumed, much more quickly than has so far happened in the months just passed.

From 1919 to 1934 there was a fifteen year period in which science was unhampered by national boundaries, in which many great advances were made, and in which cooperation of all kinds flourished so well that this was not a subject for special comment. This was a period in which American science for the first time began to mature. By that I do not mean that we were able to be, or desired to be, independent of or aloof from European science. I mean that the contributions of American science began to be an appreciable fraction of the whole, and so we in America could feel that we were beginning to repay the debt we owed to European science in getting us started.

This period began to come to an end with the accession to power of Hitler in 1933. Very soon there was unleashed in Germany a policy of violent anti-semitism which first struck the universities and research institutes. Fortunately for us this attack on the Jewish people came in such a way that many of the brilliant Jewish scientists of Germany were able to escape and to enrich the scientific life of England and America. This wrecking of the universities later cost Hitler dearly in that it vastly reduced his available research potential for military developments and vastly strengthened that of the Allies.

That some scientists were aware of what was happening is shown by the resolution which the Royal Academy of Sciences in Amsterdam presented to the International Council of Scientific Unions at its meeting in Brussels in July, 1934. It reads in part:

"The Council expresses its confidence that scientists, while giving their aid in meeting the needs of their own nations, will never lose sight of the international character of science as a whole, and will ever continue to keep in working order and to develop the connections necessary for international cooperation, even if severe shocks unhappily might come to threaten economic and political relations.

"In professing its faith in the possibili and the necessity of peace between t world's peoples, the Council points o that the 'brotherhood of scientists' c be an important factor towards the esta lishment of a desire for mutual und standing and helpfulness in order overcome the dangers involved in a too e clusive nationalism.

"The Council therefore, in emphasizi the significance of science, both pure a applied, as a common treasure for humanity, which can only be realiz through a free-spirited cooperation of t most diverse elements, is of opinion th scientists of the whole world have a ta of working for this understanding, a urges all allied organizations to give c stant attention to this task."

Certainly a fine statement written some Hollanders who were obviously der no illusions about the state of world! But the Council merely deci to take the proposal under considerati which it did, not reporting an opin until the next meeting three years la at London in April 1937. Evidently prevailing view in the Council was t what was happening in the world no proper concern of the scientists. alternative proposal was adopted to up a Committee which "should prep a survey of the most important resu obtained . . . in the physical, chem and biological sciences with reference (1) their interconnections and the velopment of the scientific picture of world in general; (2) the practical ap cation of scientific results in the life the community. The work of the C mittee is limited strictly to scien activity."

This is certainly a watered-down sion of the 1934 proposal from Ams dam.

This was no time for world brotherh of science. Cooperation withered and free spirit of science was suffocated the date of open active hostilities of W War II drew near.

WAR RESEARCH vs. TRUE SCIE

Under the necessities of war, Amer scientists laid aside their peaceful suits and by the winter 1940-41 were la ly engaged on a host of projects, utili science for military purposes. Each us has his own memories. I remem how several hundred of us gathere Cambridge in October 1940 for a l research conference on applied nuc physics — even then much was being on the use of artificial radio-active

From the first of the Frank A. Howard Lec presented on May 2 at George Washington Un sity, Wash., D. C.

ls. This was the last normal gather- of physicists in America, and even meeting was not normal since some ose present were called out to secret erences for the organization and ching of the now-famous Radiation ratory, where most of our micro- radar equipment was developed.

ery one of us had a difficult personal lem. We knew that all this war re- h is not really science. Neither does nd a better understanding of nature, does it do mankind much good in the run. However, it could do mankind a f good in the immediate future by ng the democratic nations to restore n freedom in the world, and so, there nothing to do but abandon science and to war research.

t it be said quite clearly that war rch is not true science. True science activity of free, critical, inquiring s following a certain careful method tting questions to Nature, critically ining the answers, slowly and labor- following various leads, thus grad- adding to the body of human rstanding of the world about us. In ere must be time for careful exam- on of old and seemingly irrevelant vations and for systematic accumu- of data with an explorer's basic tainty of where the process is lead-

r research is quite a different ac- . For it, the scientists are banded her to pool the available knowledge dy acquired of fundamental scientific iples. From the pool it becomes nt that some rather novel offensive efensive war gadgets can be devised— vel that at the beginning of the war of the suggestions were greeted disdain or open scorn by many of the ssional military men. The field is d up and men are assigned to de- development of devices pretty well een in advance and almost wholly dent on the application of already n principles.

s in this sense that we have to say very little scientific progress was during the war years — even the c bomb was pretty well understood rms of the basic applicable science, ertainly this was true of radar. Of e I am not competent to speak on point with regard to the medical es — some real progress may have made there.

ECY AND COMPARTMENTAL- ION SPELL DEATH OF SCIENCE

object in focussing your attention e distinction between war research rue science is to make it clear that gh war research flourished under onditions which scientists accepted during the war, true science cannot. Any attempt to perpetuate into peace-time the restrictive practices which were used during the war will have disastrous consequences.

During the war scientists not only accepted the doctrine of secrecy about their work but also the doctrine of compartmentalization. Acording to the latter a particular worker has a particular task to do and is only allowed to have access to those results of other which someone in a higher echelon decides that he needs to know. This doctrine is usually justified by two arguments, (1) that it diminishes the tendency which scientists have of following up interesting by-paths of investigation and (2) that, in case an individual who was trusted turns out to be disloyal he is not in a position to reveal as much to the enemy as if he had free access to everything.

True science cannot progress under regulations of secrecy or compartmentalization. If we try to carry over such rules into the peace-time lives of our scientists, it spells death to any form of international cooperation, hence death to the benefits we get from contact with scientists abroad, and it spells death to our own activity. These policies immediately interfere with the proper teaching of the next generation of scientists. There being no known way of picking real scientific talent in advance we must always try to teach science to many more students than stay with it as a profession. Compartmentalization implies that the main outline of a solution is in the hands of the person in the higher echelon who has to decide what each worker needs to know. That implies a higher degree of faith in the competence of the "big shots" of science than there is any basis for in fact, and sets up a procedure which can only retard the development of the young scientists. This is a matter of extreme importance in view of the fact so often emphasized that most really original discoveries are made by quite young people.

Of course, in speaking against secrecy and compartmentalization, I am speaking only against their application in the fields of scientific principles and basic data. Probably as long as we have military equipment it will be desirable to keep secret specific design features. In any case I am not disturbed about that for such a policy does not react unfavorably on international cooperation in science nor on the development of our own scientists.

This problem is giving rise to concern in England as well as in America. Sir Henry Dale, president of the Royal Society of London, in his anniversary address last November spoke of "the effect of present and prospective developments on the integrity of science itself." He said, "we have a duty to be watchful now against a serious danger to it from the intrusion of secrecy, which we know here from long tradition and experience to be alien to the spirit of scence as we have known and cherished it."

He then developed this theme by reference to the fact that the role of science in military matters was greatly enhanced by the German invention of total war. But let me quote:

"What we have now to fear is that, in default of the international agreement which we must hope and work for, national military secrecy should try to maintain, or to extend, its war-time dominance. If that were to happen we must expect it, with its new experience of the possibilities of science in total war, to be watchful for any advance, whether fundamental or technical, whether in nuclear physics or in any other progressive field of science, which could be impounded and put under seal for warlike preparation, presumably under the name of 'security'. It is impossible to forecast how much of science might thus become involved. The release of atomic energy is yet a novelty, and we have to think what might be made of it, for good or ill, 20, 30 or 40 years ahead. I think that we, as scientists, should make it clear to the world that, if national military secrecy were allowed thus progressively to encroach upon the freedom of science, even if civilization should yet for awhile escape the danger of final destruction, a terrible, possibly a mortal, wound would have been inflicted on the free spirit of science itself, to the immeasurable loss of what it stands ready to offer to a wiser world."

The restoration of freedom to science is one of the essential elements in the civilization we have all been fighting for, freedom from secrecy and freedom from national barriers. Let me quote again the eloquent words with which Sir Henry concludes this portion of his address:

"Unless the growth of international understanding and confidence can now prevent it, unless, efforts to outlaw the abuse of science for 'total war' should succeed, science may find itself again facing an attempt to impose secrecy upon it, this time in the interests of national suspicion and rivalry, and in flat negation of its true service to mankind. If that danger should threaten, can we hope that the scientists of all the world may yet stand together against it, determined to preserve the integrity of science, to prevent its further perversion from its proper and beneficient uses, and to save civilization from misusing science for its own destruction?"

FIRST STEP TO RESTORE INTERNATIONAL CO-OPERATION

What is to be done?

The important thing is to get the scientific minds of the world working together on expanding fundamental knowledge rather than on war technology, and to carry out an educational program which will extend scientific opportunity to all talented young people in every land.

Already some steps in this direction are being taken and many more will need to be taken soon. The most important point is that the problem is being thought about everywhere, and various international gatherings of specialized groups of scientists are being organized. Travel abroad is at present almost impossible and conditions in European universities such as to make such travel distinctly unprofitable from a scientific point of view.

The first great international gathering of scientists since World War II was held last June in Moscow just a month after the surrender of Germany when scientists from many lands gathered as guests of the Russian government for a two weeks long program of scientific meetings which marked the 220th anniversary of the founding of the Akademia Nauk.

The International Astronomical Union held its first post-war meeting recently in Copenhagen where astronomers of many nations planned to resume cooperative efforts and, across the council table, Russian, Americans and others made joint arrangements to carry on some of the astronomical work formerly carried on in German observatories. Many of the most important Russian observatories are in ruins, but the Russians are already hard at work on their restoration. Likewise in the field of geophysics plans are going forward for the resumption of cooperative study of the earth's magnetic field, of seismological phenomena, and in observation of radio wave propagation in the upper atmosphere and solar influences on it. In Paris next September there will be held the first post-war International Congress on Applied Mechanics, the fifth in a series begun before the war. There, scientists from many lands will gather to exchange ideas and research results in stress analysis, strength of materials, hydromechanics and areodynamics and other topics which form the scientific basis of mechanical engineering.

INDIVIDUAL vs. PLANNED CO-OPERATION

These are but three of the many scientific unions which existed before the war on an international basis. In some branches of science these international bodies played a role of lesser importance. For example, the International Union of Pure and Applied Physics has never had much influence or activity. In pre-war times there was a large amount of international cooperation among physicists. But it was largely a matter of personal visits and personal correspondence between individuals, a planless plan which worked out very well indeed.

My object in mentioning this is to allude to a matter that has been the subject of a good deal of discussion among scientists, namely the issue of the extent to which scientific research can or should be planned or organized. Here I am not thinking of organization of workers in a single laboratory as much as of organization of program between the different laboratories of a country or the world. The physicists have always been extremely individualistic in this respect. The American Physical Society does no more than provide meeting halls where physicists may present papers and prints journals in which research reports may be published. There are many people who see dangers for science in too much organization as giving rise to an elaborate machinery of committees which do very little — "stuffed-shirtism."

In Britain there has been going on for several years a rather spirited debate, in the columns of their weekly scientific journal, "Nature," between Prof. Polanyi, an extreme individualist, and Prof. Bernal, principal exponent of a philosophy of elaborately organized scientific cooperation.

Prof. Polanyi is, of course, in favor of international cooperation but he wants this to be an activity as between free individuals. He has a vision of the man of science playing in the world of tomorrow the part of the wandering scholar of the Middle Ages, when learning was considered a third power on a level with imperial authority or the ecclesiastical heirarchy. He feels that the necessary benefits can be gained without aid from national governments. All that he requires of the national governments is absence of hindrance. We must admit that there is much in what he contends, and that scientists meeting simply as scientists for informal interchange and criticism of ideas, in complete freedom from national inhibitions can indeed make an important contribution to restoration of Western civilizaton as well as to the advance of science.

Specifically, he has made the interesting suggestion that the United Nations should accord privileges of free diplomatic passage to men of science and scholars all over the world.

He says,

"Men of science are pledged to values more precious than material welfare. The world needs science today as an example of the good life. Revival of international scientific life is needed as a part of the restoration of reason and civilized inte course in Europe."

However, there are many of us w feel that what Polanyi proposes is n enough. It is alright as far as it go but there are many fields of study whi are very costly in time and necessa equipment so that it is of the utmost i portance that research be planned to av useless duplication, and accidental negl of other parts of the work. Moreover t wandering scholars, however inform will like to foregather in pleasant su roundings and some sort of machinery needed to make the necessary arran ments for their gatherings.

Dr. Joseph Needham, the British bio gist who headed the British Scient Mission to China, is a vigorous spok man for the point of view which rec nizes a place for international action. has written,

"Some of the older generation, thou theoretically in favor of internatio scientific cooperation, are distrustful any machinery for doing it. The fun mental error of believers in what we m call 'laissez-faire', however, is that t look at the scene too exclusively from European-American point of view. T parochial theory of the 'laissez-fa school is that in science everyone kno everyone else, and can therefore ea get in touch when any problem ari which calls for it. But this is simply the case in the greater part of the wo The picture of world science looks v different when seen from Roumania, Pe Java, Siam or China."

For that reason I think we must w come the resumption of activity by various specialized scientific unions the extension of such unions into fi hitherto little aided, to provide the ne sary minimum machinery for frien collaboration of the scholars.

A JOB FOR UNESCO

Before the war the activities of various specialized unions were coo nated through the International Cou of Scientific Unions, which also was sponsible for some specific activities its own such as those of its Committee Solar and Terrestrial Relationships. T work will be resumed through for arrangements to be made when its gen assembly meets in London in July of year. Also meeting this summer will the preparatory commission of the Un Nations Educational Scientific and tural Organization.

UNESCO is the most ambitious atte yet made to provide a basis for encou ing international collaboration in t fields. The meeting this summer wil for the purpose of arranging the formal meeting of the main UNE body which is to be held in Paris in vember. It is important to review bri

story of UNESCO because of the plex pattern of successive conferences which such organizations come into tence.

he decision to proceed was reached ut this time last year in San Fran- when the United Nations was be- formed. This resulted in a conference in London last November for the blishment of UNESCO, which was nded by delegations from forty-four ons. The conference agreed on a con- tion which will become effective when ty nations shall have ratified it. So only two have done so, Great Britain New Zealand, but this is not thought e due to opposition or lack of interest. conference also authorized the forma- of a Preparatory Commission to are for the first meeting of UNESCO tentatively decided that Paris will he permanent headquarters. The con- nce also adopted a resolution calling he executive committee of the pre- tory commission to work out plans collaboration with the International ncil of Scientific Unions.

course the aims and program of SCO cover a much broader field than of scientific collaboration, embracing does all forms of educational and ral collaboration, including that at- d through popular mass media such ress, radio and motion pictures. The thing about UNESCO as Archibald eish, Chairman of the United States gation has pointed out it that this is first time in history that nations agreed "to work together through hannels of communication and with he universal languages of science, nd learning to increase their under- ding of each other and to root out the dice and ignorance which have sep- d them in the past."

e London conference met just three hs after the sudden end of the war g a period when the first realiza- of the great change in the inter- nal situation brought about by the ic bomb was just dawning. This gave e conference a particular earnestness might otherwise have been lacking. eish further says, "If suspicion and between the peoples of the world become immediate and present dan- it follows that international trust confidence are no longer ideal goals realized in some utopian future, but nt and urgent and inescapable neces- to be realized at once and by every able means. . . . The stated objec- of the new organization are ob- es which have been regarded rto, as idealistic rather than practi- We feel, however, that the violent e in the character of international onships which has made international ust a mortal danger to mankind, has also made international understanding a practical and immediate necessity which must be treated henceforth as a first objective of our foreign policy."

It is to be hoped that the work of the preparatory commission this summer, together with the first general assembly in the fall, will really give us an adequate machinery for aiding the international cooperation in science which has hitherto had little or no formal encouragement from governments.

Continuing this cursory account of the story of resumption of international activities, mention may now be made of the forthcoming October meetings of the American Philosophical Society to be held in Philadelphia and of the National Academy of Sciences to be held in Washington. Arrangements have been made from private source to finance visits to these meetings of some forty to fifty foreign scientists from many countries. These will be nominated by the sister academies of science in the various countries where such academies exist. Although the exact distribution of numbers of representatives to be invited from each country has not yet been worked out, these will include all the principal nations of the world, except the enemy countries. Besides the usual scientific research papers it is planned that these meetings shall include panel discussions on many vital subjects that have been inadequately covered in this lecture such as the historical bases for international intellectual collaboration and of the present status of problems that emphasize the future needs and opportunities for scientists in the world affairs.

This international gathering, with UNESCO starting in Paris immediately after, should do much to restore the spirit of free science in the world which has been so largely suppressed during the past decade.

ATOMIC ENERGY MAKES CO-OPERATION IMPERATIVE

This report, of course, cannot really be ended without some comment on where the atomic energy situation fits into the picture of international scientific cooperation. As already mentioned and as is quite generally realized, the existence of the atomic bomb has greatly intensified the need, in fact has made it an inescapable imperative, that we achieve international arrangements of every kind which will remove the threat of war. To some it may therefore seem a contradiction that the Congress is now considering legislation which restricts scientific freedom in this field and erects barriers against international exchange of scientific data in regard to the nuclear physics of uranium fission. Of course, if this were a matter of permanent policy the situation would be very bad indeed. Our Government has however made it quite clear on repeated occasions that the policy of withholding data in this comparatively narrow field of science is expected to be only a temporary expedient. The national policy is one of working as rapidly as possible, through United Nations channels, to bring about adequate control agreements which would give everybody a proper feeling of confidence that atomic energy would not be used for military and destructive purposes. To this end the President took the initiative in bringing about the meeting with Prime Ministers Atlee of Great Britain and Mackenzie King of Canada to take steps toward formation of a United Nations Atomic Energy Commission, which will be organized soon.

In this connection, let me quote from the three power declaration in its relation to the subject of our discussion this evening. About the duties of the Commission it says "Specifically, it is considered that the Commssion might well devote its attention first to the wide exchange of scientists and scientific information..."

In the meantime and pending organization of this important United Nations body the Department of State took the initiative in getting together a board of consultants who, after long study involving a remarkably difficult interplay of scientific, technical and political problems have produced a notable document entitled, "A report on the international control of atomic energy." This the State Department modestly presents as "a place to begin, a foundation on which to build." It is tactful to put the matter this way, but actually the report presents us with a careful study which in broad outline gives us a pattern by means of which the most dangerous force yet discovered by man may be turned from an evil agency of mass destruction to a means of setting up a more perfect instrument of international cooperation than men have yet been mature enough to adopt. Personally, I am most optimistic that satisfactory arrangements can be worked out so that atomic energy will not stand out as a menacing black cloud on the otherwise clearing skies of world science.

In closing then, let me quote Winston Churchill. He is not always right, but in 1943 he said as follows:

"It is the great tragedy of our time that the fruits of science should by a monstrous perversion have been turned on so vast a scale to evil ends. But that is no fault of science. Science has given to this generation the means of unlimited disaster or of unlimited progress. When this war is won we shall have averted disaster. There will remain the greater task of directing knowledge lastingly towards the purposes of peace and human good."

Science and National Policy . . . . Lee A. DuBridg

As the scientists of this country turn from their wartime activities and look into the future of science in this country, they see a future filled with tremendous potential opportunities, but also one fraught with terrible problems. These problems and these opportunities confront us not only in our capacities as scientists, but also in our capacities as citizens.

For this reason it is appropriate that we face frankly the issues that are impending and begin at once to formulate our plans for meeting them. We must consider not only the problems of formulating and supporting, on a national scale, a program for science in this country, but we must also be formulating a policy and point of view in which we, as scientists, face two very difficult tasks.

The first is one with which we are relatively familiar though we have never before faced it on such a scale. It is the task of education. It is incumbent upon us to see that, in as short a time as possible, millions of our fellow citizens are made acquainted with at least the elements of the grim problems which they face. Every resource of the public press, the lecture platform, the radio, and the classroom must be devoted to this task.

The second responsibility is one for which we are less well prepared. This is the difficult problem of converting our expert knowledge of scientific problems into intelligent proposals for political action to meet them. In this field we are still laymen—even thongh some of us refuse to admit it. We hesitate, for example, to acknowledge that we may need help from the social scientists. And yet, after reading some of the political proposals made by some natural scientists, I am forced to the conclusion that they would have done well to get advice from the nearest ward politician. By this I do not mean that we can turn over such problems to the social scientists or the politicians—they lack full understanding of the scientific aspects of many important questions. All I am saying is that this is a field in which cooperation would seem to be appropriate. Most of us have learned during the war the immense value of cooperation between men in different fields. And we also learned how easy it really is—when the incentive and the good will are both present.

However, when we aproach our friends who are experts in political science, in law, and in international affairs, let us be sure our own scientific problems are well in mind. They will ask searching questions which we must be able to answer—or at least know why they cannot be answered.

I speak only as a physicist attempting to formulate a few of the basic principles on which our thinking as scientists should be founded in the coming months and years. I particularly want to stress that we can go only so far in our thinking if we stick to principles about which scientists are competent to speak. Eventually a point is reached where we leave the ground in which we are experts, and sail off into regions in which we are but laymen. It is important that this take-off point be recognized. It is disconcerting to hear a physicist talking one moment with great authority and competence about nuclear physics, and then to find a moment later that he is talking with an air of equal authority about problems of international government. When scientists discuss scientific matters they generally agree, and it is important to recognize our area of agreement. But as we pass over into the area of law and politics, the agreement often vanishes, and then it must no longer be pretended, especially to ourselves, that we are still talking as experts.

Now I have hinted that there are some weighty problems before the world which concern us as scientists, but I have not yet stated just what they are. Of course you will say that I don't need to tell you because it is perfectly obvious that I am talking about the atomic bomb, But, as a matter of fact, the atomic bomb itself is not the problem I wish to talk about at all. The fundamental questions concerning the relation of science to human welfare were with us long before the atomic bomb was dreamed of—and they would be here today whether or not the Manhattan Project had attained its terrific goal. However, the flash over Hiroshima has brought these problems into sharp relief and has made the general public acutely aware of their existence. The ruins of Hiroshima and Nagasaki are mute testimony to the fact that now at last these problems must be faced. Actually, however, the ruins of Tokyo and Yokohama, of Berlin and Rotterdam and Cologne, which never saw an atomic bomb, all shout the same lesson. If man is bent on destroying himself, he does not need an atomic bomb. He can now do it with ordinary bombs, with rockets, with gas. He can do it through biological warfare—a technique so full of unspeakable horrors that no one has yet dared mention them in public.

But the atomic bomb is the supreme instrument of terror. **The atomic bomb is the final and conclusive proof of the fact that there must be no more wars.** Our problem, then, is how to turn the great resources of science into the paths of peace.

SCIENCE AND INTERNATIONAL PEACE

It is just at this point that a puzzli
dilemma in our thinking emerges. W
must adopt some point of view towa
this problem of international peace b
fore a sensible discussion of the futu
of science in this country can be starte
And the point of view to be adopted ca
not be chosen on purely scientific groun
and different scientists have adopt
different points of view. I think, inde
that there are at least three points
view which can be defended. The difficul
is that many who speak on the subj
do not make it clear which point of vi
they have adopted—which set of assum
tions they have chosen.

All three of the points of view I ha
in mind start out with the same ma
premise—namely, **the supreme issue**
fore all people of the world today is
elimination of war. All other plans th
are made, or hopes that are cherish
may be wrecked unless this need is f
filled. Granted this, however, we can n
proceed in three ways: first, we m
say that all else is unimportant and
relevant; all our efforts and thought m
be devoted to this one goal. Until t
goal is reached there is no point in c
sidering an American program of scien
Or, second, we may say, yes, the elimi
tion of war is our main job, but it is
for the statesman and politician, not
scientist. The best thing we can do
devote our full efforts to the advancem
of science, and let international affa
take care of themselves. The third po
of view is one which I shall adopt—
hence I shall try to state it carefu
The attainment of international peace
a matter of prime concern to me as
citizen and as a scientist. Wherever
talents and help can be of use toward t
end they shall be freely given. But
cure international peace can be obtai
only through world government—
establishing a stable world governm
will be a slow and difficult process.
will be approached one step at a ti
over a period of many years. Progr
toward the goal will be measured in te
of growing international understand
and good will, in terms of improv
economic and social conditions in all co
tries, in terms of a gradual spreading
the spirit of freedom and democracy.
all of these things science can m
important contributions. Hence the gr
est service that scientists can rende
to see that, first in this country,
then in the whole world, science is str
and free. We should see that internati

From a speech delivered before the Sigma X
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of Sigma Xi.

laboration in science is restored at once set the pace for international understanding in other fields. We should see at home and abroad the methods, the t, and the accomplishments of science made widely known to the public—hat the public may better understand science can contribute to the welfare rather than to the destruction of kind.

hat is the point of view from which I proceed. I shall not try to defend r it is based frankly on feeling rather on logic. Nevertheless, I trust you later agree that it is a useful con-. For at least it lets us get on with important problem of how best to and develop this country's scientific urces in the critical years that lie d.

EDOM OF SCIENCE

t us consider, then, the basic factors ired in order that science in this try can be a more potent force for progress in our national life and in d affairs.

rst of all, science must be free. To a tist this statement is so axiomatic it is hard to realize that it is ever tioned. But it is being questioned in this country. It is being questioned some who do not believe that science ld be free, and it is being questioned ssibly unintentionally—by some who ot know what freedom in science means.

eedom in science means everything freedom ever means. It means, first l, free exchange of ideas and free ssion. It means, also, freedom from ols and restrictions; it means freefrom direction and so-called planning above; it means freedom from red and administrative complications; it s freedom from pressure, freedom fear—and, yes, freedom from want. ere are some who believe that all alk by scientists of freedom is simn expression of their reluctance as duals to give up certain personal eges which they cherish and are elfish to relinquish for the common We must, of course, be very sure this is not the case. I think it is lantly clear, however, that whatever ersonal desires of the scientists, intual activity of the highest type shes only in the atmosphere of greatreedom. This is a simple fact—and is to the good of the country to rage intellectual activity, our first must be to provide the proper atmos-.

greatest immediate threat to the m of science comes from those who e that, in certain fields at least, freedom is inconsistent with military ty. Here we face a knotty problem l, one which I have not time to ze tonight. It has been discussed most capably by L. N. Ridenour*. I need only say here that in times of real national emergency, when most of the scientific effort of the country is devoted to military problems, a certain amount of secrecy, even on matters of basic science, seems necessary. But at present, secrecy on basic scientific matters is not only unnecessary, but it is dangerous. It is unnecessary because the facts of nature cannot be kept hidden anyway. It is dangerous because it interferes with our own scientific progress, gives a false sense of security, and endangers international good will and understanding. The earlier statement by President Truman, and Prime Ministers Attlee and King that we stand ready to participate in free international exchange of basic scientific information, even in the field of nuclear physics, commands the heartfelt support of all scientists. The release of information in this field has not yet been accomplished. I am assured by those who know that it soon will be, but that it will take months to write up and publish the huge mass of scientific data that has been accumulated.

In any case, we as scientists must hold fast to the principle that unless or until this country is again obviously in imminent danger of war, there shall be free exchange of scientific information. We must here recognize, however, that just because of the perils that science itself has introduced into the world, there can be no real freedom in science as long as there is war or the fear of war. Our fight for peace and our fight for freedom thus are one. Peace only will insure our freedom—but, conversely, freedom can do much to promote peace.

Freedom, then, is the first and most necessary requirement for science in America. Without it all else is lost.

TRAINING OF SCIENTISTS

The second requirement is that there must be scientists. There must be more scientists, but especially there must be better scientists. I need not repeat here the details of the well-known and tragic fact that a college generation of young scientists has been lost during the war. I need not remind you that we are not making great progress in retrieving this loss. Scientists are still in the Army; young ones are still being drafted. Let us hope that someone will soon have the political fortitude to remedy this.

Eventually we must seek our future scientists from the school children of this country. A national program of scholarships which will give every promising young man or woman of whatever economic level the opportunity of pursuing his training in science as far as his ability will take him, would be one of the finest and most productive national investments that could possibly be made.

This fact is, I think, admitted by all and need not be further emphasized. But there is a corollary to it which has hardly been mentioned. If there are to be many more students of science, there must also be more and better teachers. Of course, many of the students will eventually become teachers, and we are inclined to think that everything will work out all right in the end. There are some disturbing problems, however. The first is that the quality of science teaching now found in most junior high and high schools in this country, and in many junior colleges and some liberal arts colleges, is disgracefully low, and I know of no really effective measures which are being taken to remedy the situation. Of course, the gifted science student comes through in spite of everything, and eventually has his early inadequate training remedied in a good university graduate school. But the non-science student and the less gifted ones who do not survive the uninspired drudgery of their school years are still left out in the cold. It is surely disgraceful—it could be disastrous—that in an age of science a large share of the population of this country are scientifically illiterate. We, the scientists, are largely responsible and at least are the only ones who can change the situation. I should like to see Sigma Xi take the initiative; first in setting up an adequate study of this problem, and then in enlisting the support of private and government agencies in carrying through a well-considered program aimed at giving the non-science college graduate a better appreciation of the spirit and fundamental philosophy of science.

SCIENTIFIC RESEARCH

The third plank in our national science program—and again one which can be effective only if the first two are well established—is more adequate support of scientific research.

Much has been said and written in recent months on this subject. The most complete analysis is that given in the Bush report, "Science, the Endless Frontier." The revelations of the great scientific achievements during the war have inspired wide public discussion of the problem. I believe the American public is now convinced that a large national program of scientific research can contribute as much to national welfare in time of peace as it contributed to national security in time of war. The testimony before the Joint Senate Committee, the comments in the public press and on the radio, have been almost unanimously in favor of a federally supported program of scientific research.

But the very unanimity of this support should put us on our guard. The impression may be established that since a na-

* Bulletin Vol. 1, No. 6.

tional program of scientific research is such a good thing, it does not make much difference just how it is set up. This is thoroughly false—for a bad program could be worse than none.

In addition, the general public may be expecting things from such a program which it can never yield. I am sure many people believe that, after a couple of years of federally supported research, there will be cures for cancer, jobs for everyone, and cars that will run forever on a half a glass of water. If someone suggests that this may be expecting too much, the answer he receives goes like this: "Well, we got radar and the atomic bomb, didn't we? That just proves that nothing is impossible. Just gather a lot of scientists together, give them a big laboratory, and lots of money and tell them what we want, and we'll get it."

I regret to say that this attitude is not so much an exaggeration as we would like to think. Such an attitude is wrong and dangerous for many reasons—but principally because it reveals a misconception of what must be the major goal of a national research program. To the man in the street the practical results of applied science are real tangible things. He does not realize that applied science is built on a foundation of pure science, and that it is the foundation and not the superstructure which is in greatest need of strengthening.

Indeed, bringing out the fact that there is distinction between pure and applied science is one of our most difficult problems in present-day discussions. This is partly because the distinction between the two is not always a hard and fast one—and partly because our terminology is not too well defined. What exactly is meant, for example, by pure science or pure research, basic research, fundamental research, and just research? Also what is meant by applied research and applied science, clinical research, development, engineering research, technology, and so on?

For the purpose of this paper I shall use the term pure science, or research in pure science, to mean those aspects or activities of science which are concerned with formulating and extending our understanding of nature and its laws, without regard to the immediate practical ends. To cover those aspects and activities which relate to employing the results of pure science to solve definite practical problems, I shall use the term applied science. Applied research in the physical sciences is also called technology, and in the medical sciences it is referred to as clinical research. I do not particularly like the term "pure" science—because of its implication that other branches are impure. But it is widely used, and, in particular, it has been adopted in the Bush report, which has had wide public distribution.

You will see that distinguishing between pure and applied science in this way brings out the fact that pure and applied research do not necessarily differ in the nature of the work done, the methods or equipment used, or the type of talent required. They differ only in their goal. Thus a physicist scattering neutrons from uranium in order to learn something about nuclear forces is doing pure research. If, however, he is doing the same experiment because the results are urgently needed for the design of an atomic bomb, it is applied research or technology.

Clearly, what this country needs is a complete well-rounded program in pure and applied science. However, I should like to urge that scientists unite in making it clear, first to themselves, and then to the rest of the world, that in formulating such a program it is the problem of pure science that needs first attention. In particular, the major goal of any federal foundation or commission in science should be the support of pure science. This is not the same thing as saying that technology and clinical research, or applied research in general, are not important. But pure science comes first.

First, because it really does come first—you cannot apply science until you have science to apply. You cannot build a house until you have a foundation. There are many fields of technology in which progress will soon be stopped—unless the foundation of pure science on which they are built is rapidly extended. In particular, atomic energy will not be available as a useful peace-time tool until more is learned about nuclear physics.

Second, pure science must come first in our national program because it is the field most likely to be crowded out or inadequately supported unless it is so emphasized. As the Bush report so clearly states, "Under the pressure for immediate results, unless deliberate policies are set up to guard against this, applied research invariably drives out pure research."

Finally, pure research should have first call on public funds because many fields of applied science are either immediately profitable—and hence will be adequately supported by industry—or else have wide public appeal and hence attract large private gifts.

Having made this case for giving first priority in our support of research to pure science, let me hasten to add that there are a number of fields of applied science where public support is also necessary and desirable. In judging which fields these are, we should ask two questions: one, is the field of importance to national welfare and security; and two, is it a field which does not command adequate private support? I think it shou always be kept clearly in mind that fe eral support of science should suppl ment and not replace private support.

I think it is evident, if we apply the criteria, that research in many fields medicine, in public health, agricultu housing, and similar fields should co mand extensive public support.

And it is also clear that the gover ment must support research related national security. In our progress towa the goal of world peace, research on mi tary weapons will give way througho the world to research for the benefit humanity. Unfortunately, we are not y far enough toward that goal to aband now all research aimed broadly at suring the real security of this count Indeed, if properly conceived and carri out, such research may advance rath than retard the cause of world peace.

Let me now summarize the goals I ha outlined for a national program for s ence. First, science must be free, and wh ever our national program or the mecha isms adopted to carry it out, we must sure that freedom is maintained. With this we have nothing.

Second, our next most important ne is for the training of scientists and proper education of the public in scien

Third, we must expand, strengthen a improve our resources, facilities, and p sonnel for first-quality research in p science.

Fourth, we must support those fields applied science which are of importa to the national welfare and security.

I cannot say too often, however, t lying at the base of our national progr and permeating every phase of it, th must be the realization—the practi realization—that science is not a natio but an international problem. The laws science know no political boundarie recognize no mountain or ocean barri A law of physics discovered in Rus or Germany or Japan, is just as valid this country as there, and is just valuable a contribution to knowledge. F thermore, scientific genius is no mon oly of any nation or group of nations, of any race, color or creed.

If science is international, it must really international. We cannot subsc to the idea that science in itself is that knowledge is a dangerous thing. ence is evil and dangerous only in hands of those whose intentions are We must always promote knowledge a good thing and seek to remove by w agreement the possibility of its fr being used for war. To this end we m lose no opportunity to make our in national fraternity of science the fo runner of the international brotherh of all people.

overnment Patent Rights . . . . *Gordon K. Lister*

a by-product of the vast increase in ally financed research during the me years, the Government has ac- d title to or other interests in a sub- ial number of patents. Since the rnment will probably continue to or extensive research programs in a er of different fields, it is appropriate present time to consider what course ould adopt as to patents and inven- with respect to which it has a spe- nterest. Broadly speaking, there are ps three questions to be answered. What should the Government do about patents and patent applications it dy owns? (2) What policy, if any, d the Government adopt with respect ture inventions resulting from re- n financed in whole or in part by funds? (3) What should be done inventions relating to particular i.e., the atomic energy field, where- may be desirable that patent monop- be either eliminated or substantially nscribed? Various proposals have made with respect to all three of questions and it may be of interest sider some of the criteria that may d in appraising and evaluating such sals and to indicate some of the fac- hat must be weighed in any thought- scussion of these matters.

ARY FUNCTIONS ATENT SYSTEM

vould seem desirable that all such sals be considered first in the light eir probable effect on the primary ons of the patent system. These pri- functions are:

To induce disclosure of inventions. vident that this function of the pat- stem is of no significance in cases the nature of the invention can be ined by inspection of the thing sold he market. However there are cer- ypes of inventions, e.g., chemical s inventions and improvements in nical manufacturing techniques with to which there is no compulsion to e and in such cases the inducement lose provided by the patent system lay an important part in promoting ssemination of technological infor- .

To induce the investment of venture . The patent system provides a nism whereby an entrepreneur can capital in a new and untried devel- with at least some assurance that he development has reached a prof- stage he will be able to reap more n ordinary profit to recoup his in- nt and to compensate him for the at he has taken.

(c) To promote what has been called enforced diversity of innovation. Consider the case where A and B are competitors with respect to a particular product and A has invented an improvement of the product. If the improvement is unpatented B can, and probably will, copy the improvement. If, however, the improvement is patented B will be forced to invent a new and different improvement in order to maintain his competitive position.

(d) To reward the inventor.

These four functions of the patent system are important factors in a competitive capitalist economy and to the extent that the patent system is working properly and effectively they catalyze technological progress and thereby promote the public interest.

HOW SHOULD GOVERNMENT HANDLE INVENTIONS?

Turning now to the question of how the Government should handle patents and patent applications that it now owns, it is apparent that functions (a) and (d) of the patent system as set forth above may be largely disregarded. Functions (b) and (c) can be effectuated only by preserving the patent monopoly, that is, by granting to an individual or corporation an exclusive right to use the invention covered by the patent. A number of proposals along this line have been made, but such a procedure is open to a variety of objections. It may be argued, for example, that the Government cannot lawfully grant such a monopoly with respect to a patent to which it holds title. It may also be argued that such a grant is improperly discriminatory and that such a procedure would be politically inexpedient. As a practical matter it seems likely that the Government has only two alternatives that it can adopt with respect to the patents it owns, namely, dedication to the public or adoption of a procedure whereby it charges a relatively modest fee to anyone who wishes to use the invention covered by the patent.

With respect to the matter of future inventions made in the course of federally financed research, it has been suggested that such inventions should be covered by patents assigned to the Government. When this proposal is examined in the light of the principal functions of the patent system it is at once apparent that these functions of the system are largely vitiated by a policy which provides for assignment of patents to the Government and thus the issuance of such patents becomes simply so much waste motion. It is upon this ground that many people object to the patent provisions that have been included in various bills that have been introduced into Congress for the establishment of a National Science Foundation.

Although this objection has some merit, it is rather difficult to arrive at a wholly satisfactory alternative. In the past some Government Departments have followed the practice of taking only a license under patents covering inventions made by their employees and permitting the employee to exploit his patent for non-Governmental use. A principal argument advanced in support of this practice is that it tends to attract to the Government service capable men who would not otherwise be interested in working for the Government because of the relatively low salaries it pays. However the effect of the practice is to permit the creation of private patent monopolies based on work paid for with public funds, and from this point of view the propriety of the practice may perhaps be questioned.

Superficially it might seem that the problem could be solved if the Government were to publish the results of the research that it sponsors rather than attempting to cover the results of such research by patents. One difficulty with a simple publication procedure is that it would place the Government at a disadvantage in certain special cases, for example, in the case where a private inventor makes an invention which had previously been made by an employee of a federal project but which had not been published until after the private inventor made his invention. Under such circumstances the private inventor, by promptly filing a patent application, could obtain a patent notwithstanding the fact that the invention had been made at an earlier date by the Government employee. The objections to simple publication could be largely overcome if the Congress were to provide a special statutory publication procedure and many people believe that such a special publication procedure is the simplest and most effective solution of this problem.

ATOMIC ENERGY PATENTS

The patent problems presented by the atomic energy development are in some respects simpler and in some respects more complicated than the patent problems presented by federal research in general. It seems very unlikely that any private industrial activity in the field of the production of fissionable material and in its utilization for military applications will be permitted in the foreseeable future and thus the normal functioning of the patent

Government Patents

(Continued from preceding page)

system in these fields is effectively prevented quite apart from any specific patent provisions. Under such circumstances there would seem to be no very persuasive objection to the elimination of private patent monopolies within these fields. The Congress under the Constitution has an unlimited authority to determine what subject matter shall be patentable and it may therefore eliminate patent monopolies very simply by providing that no patent monopoly shall be granted within these designated fields of activity.

The handling of inventions relating to the nonmilitary utilization of fissionable material raises a number of more complicated questions. The choice of a policy with respect to inventions of this type depends, in large measure, upon the extent to which private industrial utilization of fissionable material is to be permitted. If industrial utilization of fissionable material is to be prohibited, then the normal functioning of the patent system is effectively suspended quite apart from any specific patent provisions and therefore the particular nature of such patent provisions becomes a matter of slight consequence. If, on the other hand, industrial utilization of fissionable material is to be permitted, then there is at least some basis for arguing that private patent monopolies in this field should be sanctioned to an extent sufficient to permit the normal functioning of the patent system.

Assuming that industrial utilization of fissionable material is to be permittted either immediately or at some future date, there remains the question of the extent, if any, to which the use of patents in this field should be circumscribed. It has been suggested that such patents should be subject to compulsory license, i.e., that the atomic energy Commission should have the power to declare such patents affected with a public interest, to grant licenses to its designees under such patents and to determine what payment, if any, should be made by the licensee to the patent owner. The desirability of establishing such a compulsory licensing procedure is an issue on which reasonable men will differ. On the one hand, there is a feeling that since the atomic energy development has so far been financed with public funds, an effort should be made to keep the field completely free from private monopolies. On the other hand, it is clear that a compulsory licensing procedure weakens the patent monopoly and hence necessarily vitiates in some measure the primary functions of the patent system as set forth above. The question is a close one and a careful weighing of the factors pro and con would seem to be indicated to determine what course will most effectively advance the public interest.

A further complication arises out of the fact that many inventions are characterized by multiple utility, that is, they may be used either within or outside the atomic field. Thus in evaluating each proposal with respect to patents in the atomic field it is necessary to consider, in the case of multiple use inventions, the possible effect of the proposal upon that portion of the patent grant which covers the outfield uses of the invention.

THE SIGNIFICANCE OF THE NAVY TEST

. . . . DuBrid

(Continued from page 7)

are far below the human danger point. But photographic plates and sensitive physical instruments can be affected. This is a cost not to be neglected.

4. THE IMPLICATION

Are international relations to be improved by these tests? Not even the greatest enthusiasts for them has claimed this. They will either be unaffected or harmed. Let those more competent in these matters than I judge the extent of the harm. I will say only that at this critical hour they are in poor taste. Some foreign representatives are to be witnesses — on a limited scale. Already foreign correspondents — even British and Canadian ones — are complaining that they are grossly underrepresented.

One can do target practice with a gun (even a 16 inch gun) in his own "backyard" without foreign complications. But brandishing atomic weapons is in a different class.

And how will the results of the t be represented to the American peop Regardless of what the results are t will stimulate exaggerated claims counter claims. "The Navy is invul able!" "The Navy is obsolete!" "Arn are useless." "We must have unive military training." These and other c clusions will be drawn — from tests wh have no bearing on such fundamer issues. This the American people n understand and expect in advance. T only will such wild claims be prop discounted.

The fact is that if one wished to des a fleet with an atomic bomb he w first study the most effective way of u it against a fleet. It is unlikely that would turn out to be with an air bu still less a surface burst. Hence the vulnerability of a fleet is really not b tested at all. The underwater test 1947 — if it is held — will probably more informative. The air blast may a couple of small ships — or may Experts can probably make a good diction. In any case the result may the public to think the bomb is not so after all. But let us not let anyone m us believe that the test has any bea on the future military or internati policy which this country should ado

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he International Control of Atomic Energy

. . . . J. Robert Oppenheimer

ithin a few weeks the United Nations Atomic Energy nission will meet. If their meetings are successful, there come out of them some sort of charter or set of treaties. ese are any good, if they follow proposals which have of effectiveness, they will require ratification by the Senate e United States, because they will involve a partial abroga- of our national sovereignty, a giving up of what may ap- to be at least a temporary security; a loss in our polistic position of technical advantage in the field of c energy. At that time, and in the period leading up at time, it is of the utmost importance that the officers e Government feel that they have behind them an informed nlightened and courageous citizenry.

u may think it odd that I should be dealing with a prob- f statecraft. For that I have two apologies. One is that the privilege of working on these questions with a board nsultants to the State Department. The five of us had different backgrounds; and although we felt we were ualified to discuss many of the more finely diplomatic s, the agreement that we reached, the intercourse and hange of ideas that went into writing our report, gives me confidence that the views I am presenting are not personal views. For another thing, it may be permitted nen who have no qualifications in statecraft concern them- with the control of atomic energy. For I think that the l of atomic energy is important, in part, because it s us to get away from patterns of diplomacy which are, ne respects at least, unsatisfactory as a model for the ns between nations, and to set up instead a working nship between the peoples of different countries, which it some promise for the future.

lon't need to review the arguments for seeking inter- al control: the appalling and revolutionary character of eapon, the inadequacy of military defenses, the impossi- of any permanent monopoly which might protect us— American knows that if there is d World war, this country will be ed, maybe fatally wounded, will in ase come through it with nothing he freedom from injury which we had in the last two. Every Ameri- ows that if there is another major atomic weapons will be used, and he problem we are dealing with is roblem of the elimination of war. now this because in the last war, vo nations which we like to think ne most enlightened and humane e world — Great Britain and nited States—used atomic weapons t an enemy which was essentially ed. Under these conditions it is inkable that in any future major t, where the very life of a nation e at stake, these weapons will not be -they are much too effective for that.

This is an important thing to keep in mind, because it shows that we must ask, of any proposals for the control of atomic energy, what part they can play in reducing the probability of war. Proposals which in no way advance the general problem of the avoidance of war, are not satisfactory proposals.

The threat of atomic warfare and the rivalries for raw materials, for industrial capacity, for power plants, for technical know-how, for scientific experience, which are inherent in any struggle to maintain superiority in the field of atomic weapons, must not be allowed to persist and be in themselves a source of war. If you think of the dangerous situations which have arisen in the world because of the struggle for raw materials, far less critical than uranium, for oil, for instance, you will see what sort of thing I have in mind.

One may say, since the problem is the avoidance of war, why do you not attack it more broadly and more generally? Why not start right away on some of the things that we know might lessen the danger of outbreak of war? What are they? Well, I don't know, but I think when people say if we had universal disarmament, that is, if national armaments were forbidden, this would reduce the chance of war, they have something. When people say, if we had a world government, and if, on matters affecting the common security, the sovereignty of the nations was limited, they have something. And I think when people say that if we could provide for all peoples in the world a rising standard of living, and better education, and more contact with one another, better understanding of each other, and equal access to the technical and raw materials which are needed for improving the standard of living, they have something. It is not my intention to argue that these things should not be done; that would be quite wrong. They must be done. But I think that no one could have looked at the history of the world without being aware of the fact that progress in these fields is rather slow, and is likely to be very slow. I therefore wish to stress the fact that in the field of atomic energy, certain of the difficulties which exist in other areas, are absent; and wish to suggest that in addition to a general effort all along the line, a specific effort focussed on this one problem may have a very useful part.

Now, what are the specific points about atomic energy? The main one is that one *can* set up a system of control. When I use the word *can*, I mean it is consistent with the technical facts, it is consistent with the way ordinary people behave, it will work in a human sense and a technical sense. One reason for this is that it is a subject of the most extraordinary common concern. I know of nothing which is of as little to the advantage of any men anywhere as that atomic warfare should break out; I know of nothing which is as sure to bring ruin to all as that atomic warfare should

In This Issue

The United Nations Atomic Energy Commission convenes on June 14.

To assist in the understanding of problems which confront it the Bulletin brings several articles on the international control of atomic energy—by **Prof. J. R. Oppenheimer,** University of California, formerly Director of the Los Alamos Laboratory, co-author of the Acheson report, **Prof. E. Teller,** University of Chicago, **D. L. Inglis,** Johns Hopkins University, **E. Rabinowitch,** one of our editors, who helped prepare the Chicago Draft Convention, and by a distinguished group of **Atomic Scientists of Great Britain. Prof. M. Kamen,** George Washington University, discusses the use of tracers in biology.

break out. I know that in the exploitation of the constructive uses of atomic energy there is a diffuse, and at the moment not clearly defined, but sure benefit for all peoples. And I think that the overriding importance in this field of those interests which the various nations have in common, and the relatively secondary importance, although not negligible, of the separate national interests, is one of the points which makes this a field to make progress in. Another one is that it is a field that has not been limited in the freedom of action by centuries of tradition. It is a new field, and with the exception of the United States, it is a field of which it may be safe to assume that not a terrible lot of progress has been made elsewhere; it is a field in which what you do now is not as much an eradication of past patterns as the building of new ones.

OUTLAWING USELESS

If we ask, what are the methods by which one might control atomic energy, one finds a rather surprisingly small number of ideas. I think no one would seriously argue that the world is such today that a convention saying, "we will not make atomic weapons", would have much value. This is a sad fact; it rests upon the lack of community, the lack of fraternity between various peoples, and the terrible strain which suspicion and fear will put on such convention. We know very well what we would do if we sign such a convention—we would not make atomic weapons, at least not to start with, but we would start out and build enormous plants, and we would call them power plants—maybe they would produce power; and these plants we would design in such a way that they could be converted with the maximum ease and the minimum time delay to the production of atomic weapons, and we would say, this is just in case somebody two-times us; and we would stock-pile uranium, we would keep as many of our developments secret as possible, we would locate our plants, not where they would do the most good for the production of power, but where they would do the most good for protection against enemy attack. We would do that, and it is reasonable to believe that all other nations would do it, and with the secrecy which inevitably surrounds such undertakings, suspicions would be very hard to resist. A system of that kind is sure to collapse as international tensions grow—and they are sure to grow in one time and another. So people have thought of methods of reinforcing such conventions, and I have heard of three such methods, of which I wish to disparage two, not as wrong, but as inadequate, and of which I wish to speak up for one.

REGULATION AND RETALIATION INSUFFICIENT

The two control methods that I wish to disparage one may call the *regulatory*, and the *retaliatory* methods. By *regulatory approach*, I mean the following: you may say, all right, let us sign this convention; we don't trust one another, and therefore the next step is to set up a system of control, whereby we can find out whether these conventions are really being observed. This is usually called inspection, and the idea would be this—that you leave in the hands of nations, or of nationals, as the custom of the country may be, the development of atomic energy, the production of power, research activities, the manufacture of fissionable materials. You super-impose on this national development, a super-national agency, a corps of refined policemen, whose job it is to go around and see that nothing is happening that is contrary to convention. There are really two points to this: first, you must see that no enterprises are being carried out which are not allowed, and second, you must see that the allowed ones are really doing what they say they are doing, and not doing something wicked on the sly. There is a great need for such regulation, and any system of international control will have some of it. But I, and the group I worked with, felt completely desperate about the attempt to build this cops-and-robbers scheme into anything really effective, because it seemed to us the robbers always have the advantage and the cops are always dumb cops. It is true that you can't mine uranium in the back yard, but there are lots of places you can mine it, and even the detection of uranium mining might be a difficult thing for an outfit which had no other purpose than detecting illegal activities. There is very much more than one way of going from the raw material to the bomb that we know of, perhaps four or five that work today, and we are quite sure that new ones will be discovered. I'm afraid the cops ould never know about the new ones, only the robbers. The national rivalries which are permitted to exist under these conditions, will cause every nation to come as close to evasion as they can, and instead of having a situation in which it is to the advantage of the operators to do things safely, you will have it to the advantage of the operators to cut corners just as much as possible, because the operators are concerned with their own national advantage. You see a great plant that is going up, and you were assured that this plant has as its purpose only the production of power for this poor town that has never had enough, and you look at the records and it looks to you as though there were plenty of power there, and you have to begin worrying about what the real purpose of the people who are buil ing this plant is, and purpose is a ha thing to establish. It's very hard to t whether a man is mining uranium becau he is interested in cancer or interest in war.

We came to the conclusion, not that o could survive *without* such regulation, b that such regulation must be reduc and that one must make arrangemen for converting the regulatory agency i a research agency, a development agen a constructively operating agency, if was to have the people, the know-ho the skill, the progressiveness, and, in general way, the power, to find out enou even to know what it was looking f And that is a quite different thing fr national operation on which an int national supervision or inspection h been superimposed.

Now, the *retaliatory approach* may a have something in it; but I think it has in the form in which it is usually p posed, that is the following: let us ma a certain number of bombs, 100, 250, a let us give them to an internatio agency, then this international age will be able to punish any state wh starts atomic warfare, or which ev looks as though it were going to st atomic warfare. It would be an ea thing to prevent war if you could be su that whenever any national action w contrary to the general interests, all oth nations would gang up and stop it. B experience shows that this tends not be true, that very broad cleavages occ differences of opinion, vacillations, a that you do not have that effective op ating unity which enables you to put yo finger on the transgressor.

Then, I think that atomic weapons a singularly unsuited as police weapon they are much too much weapons of to war. And in the third place, you m say about bombs that they are int national, and may paint them with colors of the United Nations, but yo have to put them somewhere, and if yo put them somewhere they are capable being seized. Now any international co trol scheme is in some respects an vitation to seizure, but this one is invitation to seizure which pays off aggression immediately—there is no de between the time you seize the bon and the time when you can do dama with them. This temptation, in times international trouble, would be just o of the things that is most likely to off a conflict.

NEEDED—AN ATOMIC DEVELOPMENT AUTHORITY

We said: let us take the fact that t is a field in which useful things can done, but are hard to do; let us cre an international organization responsi for developing atomic energy, for gett what good there is out of it, and in

e time for protecting the world against destructive uses. This is an easy thing ay, but what does it mean? It means all those critical activities which or may be essential for going from mine to the weapon, are not to be ducted by nations or by nationals— are not even to be conducted under nse by a company or a national atomic rgy commission. Things like the min- of uranium, which is a unique, in- ensable raw material, are to be done an international authority; things like building of power plants, which make onable materials or which may make onable materials, things like the ration of isotopes to get explosive erials, these are jobs which are too ly diverted, too trigger-happy to be in national hands. This means that would regard the mining of uranium a national operator as a violation of convention—you wouldn't have to ask ther this mining is being conducted a legal or an illegal purpose—the fact the mining would be illegal. This ns that the construction of a primary t, a primary reactor to make pluto- , and to make power at the same , would be an illegal activity for a on; this means that research on ic explosives, which I think must ndertaken, because unless you know the possibilities are, you will not repared to prevent their realization, d be an illegal activity for a nation or nationals—it would be legal only onducted by an international organi- n, which we called "The Atomic De- oment Authority" in order to suggest east two important aspects of its tion—it must have very wide authori- and it must really make for develop- .

ADA AS MINING AGENCY

w, let me go over it again. The ic Development Authority would be onsible for *mining uranium and um;* this a matter which requires a deal of detailed study, because we know enough about the geological ibution, we don't know what the bilities are of working low-grade de- s—deposits under about a per cent normally not taken seriously. These roblems of development and research; vant them to be undertaken inter- nally, so that the body which is try- o protect the world, will know more the dangers and about the possi- es than all the other people in the . You never get experience in min- ranium by sitting at a desk talking how other people are mining it— e got to get into the field and get hands dirty. This would mean that tomic Development Authority would the position to say, let's not mine ranium here, because it's too hard event diversion, let's not worry about this mine, because in it the by-product uranium doesn't amount to enough to be a danger, but in this mine, the by-product uranium is so important, that we've got to have really close control, even though the mine claims to be, in large part, a mine which is putting out vanadium.

THE ADA AS RESEARCH AND POWER DEVELOPMENT AGENCY

At present, there are no power plants, and the first thing the authority would have to do is find out how to make them. This I think, will be a matter of years, not decades. The authority would then start building such plants, taking into account the following factors: first, where is power needed; second, how can we do this in such a way that in no one political sphere of influence in the world, in no one nation, is there a preponderance of these plants, which, if seized and diverted, can in time make atomic explosives. How can we make these plants so that their seizure and diversion is as little profitable as possible, so that the time needed to convert to the manufacture of explosives is as long as possible? These are then some of the questions: the economics of the power, sociology of the power, strategic balance to make diversion and seizure an unprofitable business, safe design. These are things that you cannot do by regulation; you can only do them by operation.

As far as *research* is concerned, most of this has no essential danger in it. At least, it is not my view that knowledge is the source of danger; the source of danger is weapons. Therefore, it was our hope that the Authority would conduct its own investigations, but would in no sense attempt to have a monopoly, even on those investigations which bear directly on the release of atomic energy. There is only one field in which we felt it desirable that there be a monopoly in research, and that is with atomic explosives, and I think the reason for that is obvious —there is no reason why a nation should explore this if it does not wish to use it. There is reason why the international organization should explore this, because it has the responsibility for seeing that no one does this, and unless it knows what the "this" is, and can define it, it can't see to that.

WIDE SCOPE OF PERMITTED NATIONAL AND PRIVATE ACTIVITIES

We were aware that in setting up a monopoly, which might in the course of twenty years produce a very substantial part of the power of the world, and which would be very important to the economy and life of the nations, had some dangers, and this we thought we could meet in the following way: Many of the constructive uses, which have to do with making tracers, operating small reactors for research purposes, using radiation to study changes of biological and chemical systems, are not intrinsically dangerous. You can set the reactors up so that they do not make enough fissionable material to be significant from the point of view of atomic weapons. You can set them up so that the material contained in them is (a) not enough to make atomic weapons, and (b) not very useful for that purpose,— being in such a state that you've got to doctor it in a rather long process, before it can be used for bombs.

Another thing: one can build power plants, instead of producing additional plutonium, or other fissionable material, burn it up, and a plant of that kind is in many ways very much easier to inspect, because if any one diverts any of the material, the plant has to shut down, and this is a rather easy thing to notice. It can be designed in such a way, that you can't smuggle uranium or thorium into it, and convert them into fissionable material, without that being observable to the most casual inspector. You can use in such plants active materials which are as unsuitable and as difficult and as inefficient for making of atomic explosives as possible, and therefore reduce the temptation to seizure.

These then, we thought, were the kind of developments which could and should be left to national or private exploitation: research, of course, whether it bears on radiations, or on power, or on atomic energy, or on anything else but atomic explosives; the use of tracers, the industrial and medical use of radiations, and the power plants which are, by the material in them, and by their design, and by the fact that they are destroying rather than creating explosive material, rather easy to inspect—not so that you can forget to watch them, but so that the watching is a fairly straight-forward task. We thought that it would be a great advantage if these things were left free for competition, under a system of licensing and inspection, because this will lead to an intercourse and a connection between the technical people of the international authority and the technical people who are not part of it. This will produce several benefits: In the first place, if you have a total monopoly, you are always in danger that something will go sour with the organization, and the people will become second-rate, they will get to be friends with each other, and will no longer be exposed to the necessary criticism. In the second place, if you have no organic relation with national undertakings, you will have a much harder time finding out whether they have any dangerous tendency or not. If you are working in a national laboratory, trying to show people how to use a reactor, and also watching so that nothing wrong be done with this reactor, in the dual role,

that is, of a helper and an inspector, you're going to pick up the gossip of that laboratory, you're going to be free to pass on the gossip of your own outfit, and there is probably no better way of really having cognizance of what is going on.

This does not in any way eliminate the need for inspection. What I have tried to indicate is that it simplifies the problem enormously, because you have valid points of contact with national industry, because you are looking, not for a purpose behind an operation, but for the existence of an operation; because you are not a man who is trying to keep up with someone who is running much faster than you can, but the top guy, who knows as much or more than is known to any other group, because it is your job to know it.

This, then, is the pattern we had in mind: *The setting up of a genuinely international development authority, entrusted with the dual function of rapidly developing the beneficial uses of atomic energy, and of being responsible for preventing its abuse; the licensing of activities which would not make for national rivalry, which do not lend themselves to the making of weapons, but which are technically closely enough connected with the atomic energy problem, so that by their licensing, one would have established a living relationship between national and international experts.*

WHAT SECURITY CAN ADA PROVIDE?

Now the questions of what this authority might look like, how it is set up, what sort of procedures it has got to follow—those are extremely complicated, and there are two kinds of considerations, involved in the process of arriving at agreement on them. One has to distinguish very clearly between considerations which are essential for the *workability* of the plan of international control, and those which may make this plan *acceptable* to one nation or another. There are many problems we must explore, but I think it is meaningless, at the present time, to lay down a schedule which would fully protect the United States and be ideally suited to the securing of our own national interest, because this is the job which the U.N. Commission must undertake. The Commission must attempt to find some workable compromise between the conflicting national interests. In doing so it must come back again to the fact that, although these interests do conflict, these conflicts are trivial compared to the overwhelming common interest in getting the security we are after.

What kind of security is it? It is not the elimination of war, and, as we have said, if war breaks out, you'll have atomic bombs. It is a guarantee that at a given time there are no atomic bombs, that no nation is either mining uranium or processing fissionable material, or manufacturing bombs, or set up to do any of these thing. If this plan works, the first step which would have to be taken by a nation bent on aggression is either the seizure of the facilities belonging to the Authority or the violation of the convention by which the nations agreed not to build certain kinds of plants, not to mine certain ores. Now this *may* happen—but I don't think it will, because the nation doing it will be coming out and saying, "We're going to make atomic war," and gives you a clear warning. Now the time might not be very long; it may be a year, maybe somewhat longer, conceivably even somewhat shorter, before the seized facilities or the new facilities which a nation can build, will make major atomic warfare possible. But the violator will have raised the brightest red flag he can, and every other country will know that they are in for it. Now this is, I think, about as much as you can expect if you want to use retaliation as a method of preventing atomic warfare. You can insist that the danger signal flashes early enough and that it be clear enough, so that there can be no mistaking the fact and purpose of a violation.

Now, that is one advantage. The other is that the Authority can really get ahead with the uses of atomic energy. I don't regard this as the thing that, in itself, would be worth all the fuss, but the point I have tried to make, is, that if you don't try to develop atomic energy, you can't control it—you can't say first we will control it, and then we will develop it, because the developmental functions are an essential part of the mechanism for control.

A PATTERN FOR CO-OPERATION

Third, the plan will bring together, in a constructive, collaborative effort, men of various nations, on a job of vital interest to the maintenance of peace, and the furtherance of human welfare. This is something rather new; you will get, not only ambassadors, but chemists and physicists, and business men and engineers, working together with a purpose which is completely common, and in which they will find out how to overcome their national differences, because there is nothing in the set-up which exacerbates their national differences. It is a scheme in which the extreme nationalism, which we all feel to be the true poison of today in the world, will have no place, and in which the sense of fraternity and common understanding will have a chance to get some place.

It will do more than this, because by removing from the world the fear which you don't know today, but which five years from now, eight years from now, you would otherwise know in the most terrible form, the fear that any day n an attack may be coming, it will rem one of the most frightful causes of w itself. Mark my words, *if there is international control of atomic ener the next war would be fought to prev an atomic war, but it will not be succe ful.* It will do more than this, beca once you have started a program l this, it becomes a natural for many ot problems. I don't know very much ab bacteriological warfare, but it is cl that the purpose of it is to infect enemy and not infect yourself, and it clear that even more than atomic ener it rests on secrecy—plans of this k simply cannot be carried out if the ene knows what you're going to do—he take the same steps to protect him that you are taking to protect your population. And it is also clear that the field of bacteriology and immunol generally, there are constructive aspe I don't see any reason why, once a p of this kind has been tried and wo problems of health, of immunology, not be internationalized, too. I think this would have many advantages, f a technical point of view, and would most completely eliminate the threat bacteriological warfare.

Another point—we all know how a rivalry for raw materials has been, what a part it has played among causes of past wars. It was so re nized in every declaration this cou has ever made about access to raw terials. Well, I think if one can s the problem of uranium one can s the problem of oil, and I think that again there is a healthy pattern for tension. And I would go a little bit fur and say, if you have managed to ha working arrangement whereby you fo the worst of all arms, the most effe of all arms, the one you would wan use first in surprise, you have mad big breach in the problem of disarma and it should not be quite so hard, that has been done, to generalize armament to other weapons of destruction, and, in fact, to other wea of war.

A LONG ROAD AHEAD

Now, you may ask, what is goin happen now? Well, there will be a n ing of the United Nations Atomic En Commission, which is a sort of Sec Council with its cap on sideways, which is attended by certain scie advisors. Presumably, the ideas people have had about inspection, a retaliation, about development, about ADA, will all be aired, and I hope will be very thoroughly aired. An there is any agreement on what we heading for, then there will be r discussion about how to get there, to do about raw materials, how to started, when to stop making bombs,

o with the bombs we have, what sort ccounting do we want, when do we al what we know about nuclear ics, or about metallurgy, and so on. e are very tough problems, and it's g to be a terrible game of poker, but ou keep in mind that the poker as- s of it are secondary, that the main g is to get agreement on a system will provide security, then I think oks, not cheerful,—and I should not ; to have said anything that sounded rful,—but so worth trying, that one ot fail to get into it.

as a result of these discussions, there mething to agree on, it will have to orked into a treaty or charter, because, United Nations Commission has no r—it is only empowered to study, its power to study is limited by our ngness to make information available rs as well as of all other nations. delegate can say, "I can't say any- , my government orders me not to," I can't make any more concessions, I might as well go home." It is a y group; but if this study group ages to produce a document, that ment will call for an entirely new of international outfit, an Atomic De- ment Authority, and that authority, constituted, will have nothing in it sponding to the veto power in the rity Council; it will be an outfit n may not have the power to compel liance, but which will know the differ- between compliance and non-compli- The failure of any major nation or ation which plays a key part in atomic y to join, will mean the scheme 't work; if any nation walks out, scheme is dead; but as long as it it will be an international authority ent from anything we have in the l today; its law will be superior to aw of the land—it will be enforced e law of the land; and it will be an ization in which people of different ries will work together, forgetting countries they came from, because e got a common job to do—not for- g entirely, just as one doesn't forget one is from Georgia, but forgetting it gets in the way.

e putting of such a plan into effect equire ratification, and if the United s accepts it, it is going to give up n advantages which we possess —which we are sure we would lose ay, but which we will be scheduling se probably faster, than we would wise lose them. We are going to these advantages up, and we are to make it a crime for an American ne uranium or for the government e United States to mine uranium, re going to make it a crime for an ican or the government of the United States to process plutonium; we are going to leave these things, as are all other nations, to an outfit which has the security of the world at heart.

It is quite clear that this is a long road. I have the feeling that we have come something of a road already, but it is also quite clear that to teach the end, will call for a spirit rather different from that that has animated most international discussion, in which the separate national interests have been the overwhelming consideration.

*Condensation of the last of six "Messinger Lectures" delivered at Cornell University; reprinted by permission of the author.

A Suggested Amendment to the Acheson Report

. . . . *by E. Teller*

Everyone must agree with the purpose of the Acheson report: To reduce to a minimum the possibility of a future atomic war. Most men who have studied the report will admire the practical spirit in which the difficult problem of international control is approached. One is led to believe that agreement along the lines proposed in the Acheson report is actually possible.

There remains one serious doubt in my mind. Is the control proposed in the Acheson report sufficiently effective? Should one not try to vest the Atomic Development Authority with more concrete powers?

I recommend consideration of the following additional proposals:

Every country should be permitted to send to any country as many agents as it pleases. These agents would be nominated by the country they represent and approved by the Atomic Development Authority. Their number would be determined by the country they represent and their expenses would be charged to that country; but they would be responsible only to the Atomic Development Authority. These agents should have the right freely to inquire into any activity which may seem to them directed against their own country, or against world peace.

. It should be considered the duty of every citizen of every country to give full information to these agents of the Atomic Development Authority. International law—superior to any national legislation—should protect men who have given such information.

One consequence of this proposal is that as soon as it becomes effective, all secrecy of information must cease. It may, therefore, be argued that in this way we would be giving away more at an earlier time than is proposed in the Acheson report. I believe that we actually shall lose little and gain most important advantages.

By giving full information to all comers we shall not lose our most essential advantages in atomic power. We shall retain our present installations and we shall retain our experience in production. The latter cannot be given away except by a process of education which is likely to take years. The real "secrets" are exactly these production procedures which one cannot communicate readily but which must be learned by experience.

On the other hand, we shall have created an atmosphere of completely free discussion. In such an atmosphere alone is it possible to start with full energy and confidence the joint enterprise of exploiting atomic energy. If information were given away piecemeal—as suggested in the Acheson report—we should prolong the feeling of uneasiness and mutual suspicion.

At the same time a great number of freely circulating agents would make evasions more difficult. Thus we could be more certain that the agreement will continue to function.

The effect of the proposed measure would be to place a considerable group of men directly under an international body and to protect freedom of information by supreme international law. Thereby we should have taken a first step toward placing authority in the hands of an organization whose essential function is to keep the peace. Only such a central authority can bar the road to power politics and help us to find the way to world unity.

Finally these agents of the Atomic Development Authority would be in the position to start breaking down the barriers which now separate nation from nation. They should not, in their usual function, be considered as policemen. They should work for world unity and they must try to remove reasons for friction—both material and spiritual.

One will not gain real confidence in the stability of the world structure until tyranny has disappeared from the earth and freedom of speech is insured everywhere. To reach this goal may not be feasible in the immediate future. If the present proposal is put into effect, at least this much will have been achieved: We shall have a way to protect a man who has raised his voice for the purpose of safeguarding peace.

Memo to the UN Atomic Energy Commission

. . . . *The Atomic Scientists Committee of Great Britai*

Professors: P. M. S. Blackett, F.R.S., M. Born, F.R.S., P. I. Dee, F.R.S., P. A. M. Dirac, F.R.S., N. Feather, F.R.S., E. A. Guggenheim, F.R.S., H. S. W. Massey, F.R.S., P. B. Moon, N. F. Mott, F.R.S., M.L.E. Oliphant, F.R.S., F. A. Paneth, R. E. Peierls, F.R.S., M. H. L. Pryce, F. E. Simon, F.R.S., Sir George Thomson, F.R.S. Dr. O. R. Frisch, Dr. H. W. B. Skinner, F.R.S.

PREAMBLE:

One of the first tasks confronting the Provisional Committee charged with the formation of an Atomic Scientists' Association in Great Britain was the study of the most effective means of international control of atomic energy and the submission of the conclusions reached as a result of this study to the United Nations Atomic Energy Commission a document embodying these conclusions was prepared but we then received copies of "A Report on the International Control of Atomic Energy" issued in Washington on March 28th by the U.S. State Department. This report which will be referred to subsequently as the Acheson Report, contained the conclusions reached by a Board of Consultants appointed by the U. S. State Department's Committee on Atomic Energy and represented a much more comprehensive study of the problem than was possible for us. In many respects the conclusions reached by our committee were similar to those of this American report, and in fact the Acheson report contains all the proposals for the control of atomic energy that our committee considered essential.

In spite of this it still seemed worth while for us to issue a statement embodying the findings of our committee and to indicate the type of reasoning which had led us to make our recommendation. This statement as given below is substantially that prepared by our committee independently of the Acheson report. It has, however, been extended slightly to indicate our support of certain specific recommendations made in the Acheson report that had not been included in our original recommendations.

SUMMARY OF RECOMMENDATIONS

The recommendations which we want to make are as follows:

(a) That an attempt be made immediately to obtain an international agreement by which the use of atomic energy, the distribution of the essential raw materials for it, and the erection and operation of plants designed to, or capable of producing active materials would be strictly controlled by the United Nations Organization.

(b) That this control be implemented by a system of inspection which would give inspectors appointed on behalf of U.N.O. the right of access to any place, plant or institution in any country for the purpose of ascertaining that there exist no sources of supply, plants or installations for atomic energy, other than those approved by U.N.O.

(c) That all major sources of raw materials and all major production plants be handed over to U.N.O. and be operated (possibly by national contractors) under international management boards responsible to U.N.O. and guarded by men also responsible to, and appointed by U.N.O.

(d) The United Nations Atomic Energy Commission should undertake the construction and operation of new large scale plants for the production of fissionable material. These plants should be so distributed throughout the world as to ensure that if any nation should seize control of the plants operating in the area in which its own armed forces are predominant the remainder of the United Nations would jointly possess an overwhelming superiority in the production of fissionable material.

(e) That the disposal of active materials produced in such plants and the research, development, and production of atomic explosives be reserved to U.N.O. and that any bombs made in that way, or the bombs made prior to the operation of this scheme, be kept in stores distributed throughout the world and operated as described under (c).

This does not imply that the signatories regard the atomic bomb as a desirable or suitable weapon for carrying out the policing functions of the U.N.O. In the present state of world apprehension, however, it seems necessary that atomic bombs should be produced and controlled by an international authority to prevent any ill disposed nation holding the threat of atomic warfare over the peaceloving nations of the world. When, however, the control authority is functioning effectively, it should be possible to envisage the cessation of the production of atomic weapons and the destruction of existing stocks. Atomic explosive could then be used for peaceful purposes only.

(f) That as the scheme described above becomes effective, the existing secrecy rules be lifted, starting forthwith with the release of all basic scientific information, and that eventually all research and development be carried on freely and openly, with a duty to report to U.N.O. any significant results, which will, in general, also be published.

(g) That the free movement and interchange of all scientists, including tho working on atomic energy, be permitt and encouraged to the fullest extent.

(h) In the implementing of the abo proposals we are impressed with the fea ibility of the recommendation made in t Acheson Report of the division of aton energy activities into "safe" and "dang ous" activities and consider that an a proach of this kind gives promise of effective control of atomic energy develo ments together with a minimum encroac ment on the national sovereign rights the nations.

PART I

There is universal agreement about t urgency of the problem of the control atomic energy and of avoiding a war wi atomic weapons. We believe, however, th if there were another war between ma powers it would be impossible to preve the use of atomic weapons or other no weapons of mass destruction and th therefore the problem of preventing atomic war is identical with the probl of preventing any war.

It is, however, also clear that st towards this end are unlikely to succe unless there exists machinery for ens ing that atomic power cannot be misus

The ideal solution might well be a wo state in which there existed no soverei nations which could wage war against e other. It would, however, be futile to w for the realization of this before attem ing to institute a control scheme. We lieve, however, that it is possible achieve a measure of co-operation betw nations and to establish an atmosphere confidence, based on the experience collaboration and of the satisfactory op ation of joint projects, which will eli nate the risk of war.

For this it is necessary that nati should waive their sovereignty to the tent necessary to permit agents of U.N to inspect equipment and resources wit their territory for the purpose of ato energy control. This step, in itself, likely to make an important contribut to international confidence and, on other hand, it is hard to see how t scheme that stops short of this can g hope of success.

PART II

Various opinions have been expres about the nature of the best con scheme. Broadly speaking, one can th of five schemes representing different grees of interference with the free use atomic energy; while a choice betw

se is governed by factors some of which as scientists, are not qualified to judge, would like to discuss them and show t, on purely technical grounds one of m (viz. scheme (iv) B below) seems us greatly preferable to the rest.

) The most drastic step would be to all research and development in nu-r physics and destroy all existing in-llations. Most of us do not believe this be a realistic idea. Apart from harm e by limiting the expansion of human wledge to such a drastic extent, the l of inspection that would be necessary nsure compliance with this would meet prohibitive difficulties and would, in ition, tend to stifle scientific research ny kind and would lose to the world y beneficial developments.

i) Next, one might not interfere with arch and development, but prohibit erection and operation of large-scale ts capable of producing active mate-s in militarily significant amounts. would not necessarily rule out small ts producing material for medical and nical research and for other applica-s of tracer elements, but it would rule any plants for the utilization of nic power. This would again mean the of what may turn out to be a most ul application of atomic energy, par-arly in remote areas and for coun-whose natural sources of power are fficient. Even so, it might be consid-that this price was worth paying for abolition of war. However, the inspec-required to enforce such a scheme d only be effective if, in addition to al plants, it aimed at discovering the aration of parts for such plants or production of the special raw mate-or materials of construction that such ts require. Even if it were successful, ould break down in the event of war, experience has shown that it was ble during wartime to complete all esearch, development and erection of ts in time to have an effect on military ations. It is evident that this is all more possible now that all the funda-al problems have been solved.

i) The alternative is to allow large-plants, including power plants, but rohibit the manufacture of bombs or lants for their fabrication. In this as in the previous one, it is clear if war is unavoidable, atomic weap-will be used, and here the delay een the outbreak of war and the use tomic bombs will be substantially er than in scheme (ii). The scheme d still, however, prevent any nation acquiring a sufficient store of bombs ipple an opponent by a surprise blow, ng as the inspection system is func-g properly. This inspection would to include a particularly strict accounting for the active materials which are necessarily produced as by-products in large power plants. This scheme is made somewhat easier by the possibility, published recently in the United States, of "denaturing" active materials. In addition to strict control of the output of any declared large-scale plants, the inspection system would have to watch for the existence of illicit plants operated from undeclared sources of uranium or possibly other materials. But this feature is common to all control schemes. In one respect scheme (iii), as well as the preceding ones, contains an element of danger in that it places a very heavy reliance on the complete efficiency of inspection. If any country could evade the inspection and secretly obtain control over enough material to make a substantial number of bombs, it would then find itself temporarily in an unassailable position, since, in the absence of bombs anywhere else, it would not have to fear retaliation by atomic weapons.

It is a common feature of schemes (i) to (iii) that if they are completely successful they would still leave the problem of preventing wars where it was before the invention of the atomic bomb, and unless this problem can be solved completely in other ways there still remains the possibility of war breaking out, which for the reasons we have given, we believe would inevitably lead to atomic warfare.

In this connection, however, one should remember that the very existence of an inspection scheme would help to restore collaboration and confidence between nations and would, in this indirect way, make an important contribution to the general problem.

(iv) The next possibility, which we consider far preferable to the others, would be to continue the operation of large-scale plants, provided, however, that such operation and production will be carried out exclusively on behalf of, and under the direction of U.N.O., and to reserve to U.N.O. the right to produce and store bombs, if desired. This might appear necessary during a transition period before it is felt that mutual trust between nations has been established to a sufficient degree, but it should be understood that if such bombs are to be made the purpose would not be to serve as a general police weapon for U.N.O. but merely to provide the possibility of retaliation against an aggressor who, in some way or other, has succeeded in making or acquiring atomic bombs.

A. One might think of doing this in a single special territory set aside as the property of the United Nations and to p r o h i b i t the manufacture of atomic bombs elsewhere, but we believe that this would lead to insurmountable difficulties, for two reasons. One reason is that unless one wants to deprive all nations of the benefits of atomic power plants, the situation in respect of inspection anywhere outside U.N.O. territory would then again be the same as under scheme (iii). The second reason is that the existence of a small territory containing the store of all available atomic bombs would be regarded as a potential threat by any nation who believed that the countries located in close proximity to the territory and possessing strong armies might intend to seize control of this territory.

B. An alternative form of this scheme, which we prefer to support, would be to have plants and stores scattered throughout the world, located in several countries whose industrial resources make the construction of such plants possible. They would not, however, be owned by the countries concerned, but the countries would operate them as contractors for the United Nations. The plants would be managed by representatives of the United Nations, who would not be exclusively drawn from the citizens of the country in which each plant is located and who would frequently be transferred from one country to another. The plants would be guarded by a small body of guards serving under similar conditions. Their function would not be to defend the plant against a determined attack from the surrounding country, but they would merely ensure that it was not possible to seize control of it without a deliberate and flagrant act of force. Even in this event, the United Nations would still have available the plants and stores in all other countries, which would still constitute a threat of immediate retaliation. It would be essential for the success of this scheme to have such plants in as many countries as possible, and it would probably add to safety if the stores of bombs were fairly widely distributed within each such country.

This scheme would probably make it necessary that in general major power plants should also be owned and controlled by the United Nations. In view of the possibility, however, of operating a power plant by the use of denatured material without at the same time producing fissionable material that could be used for bomb production it may be possible to issue licenses for the operation of independent power plants using denatured fissionable material, if the control commission was satisfied that the nature of such a plant would prevent the misuse of the material it contains and produces.

With the exception of such cases, the operation of any plant capable of producing atomic energy or active materials would be prohibited and compliance with

this prohibition enforced by a system of inspection.

As far as our knowledge goes, this scheme would seem to offer the best chance of ensuring peace and of saving the world from destruction by atomic warfare.

(v) Less stringent than any of the preceding schemes would be a rule permitting individual nations to make atomic bombs, as they are permitted at present, but to require them to declare the nature and extent of their facilities and to limit by agreement the number and capacity of the plants operated within each country. A system of inspection would then be needed to ensure that there are no undeclared plants and that limitations are being observed. Apart from the question of inspection, this scheme is somewhat similar to the limitation of naval armaments in operation before the last war. It is essentially based on a balance of power which would seem dangerous in view of our lack of knowledge of the potentialities of atomic warfare and of the possibility of new discoveries. A distribution of plants, which, in a certain situation, might appear to provide security for all nations, could, as a result of further developments, turn out to give one power an overwhelming advantage over others.

(vi) The alternative to all these schemes is to do nothing and to let an atomic armaments race develop. This would happen in the event of the Atomic Energy Commission failing in its task of establishing a reasonable scheme of control, and it is hardly necessary to point out the disastrous consequences this would have. We mention this last alternative merely in order to point out that any of the other schemes, whatever their drawbacks, are preferable to allowing this situation to develop.

PART III

All but the last of the alternatives discussed above require a system of international inspection, and we want to discuss some aspects of this. At the outset it should be realized that no inspection system can be absolutely rigid, just as it is impossible to prescribe to a police department the precise steps which it should take to prevent the occurrence of crimes in civil life and to detect crimes once they are committed. One should compare the work of the inspectorate to that of detection of crimes, rather than to an organization of customs inspectors controlling limited and definite channels of transport.

The method of inspection should be directed, on behalf of U.N.O., by a body containing scientists actively engaged in the further research and development of atomic energy and capable of reorientating inspection methods as the technical situation changes. Their instructions should be carried out by a force of inspectors who will, of course, be responsible directly to U.N.O.

These inspectors must, in the first instance, have access to all known sources of the raw materials essential for atomic energy and to any plants known to be in existence for the utilization of atomic energy or the production of active materials. In addition, however, they must have access to any factory, whether privately owned or government controlled, and to any mine or store of raw materials, in order to ascertain that there exist no illicit sources, plants or stores.

Admittedly this represents drastic interference with the present freedom of individual governments or individual firms to keep their operations secret, but it does not necessarily mean the abolition of industrial secrets as such. The inspectors who visit, say, an aircraft factory, would normally possess technical knowledge not on aircraft construction, but on atomic energy plants and their sole purpose would be to ascertain that the factory does not contain secret facilities for producing atomic energy or for manufacturing equipment for this purpose; it would be quite as improper for them to communicate details of the design of aircraft that they have seen as this is now for factory inspectors employed for various purposes by governments. The inspectors would not attempt to carry out what, in manufacturing practice, is known as 100 per cent inspection. Instead they would follow up significant clues and they would be advised by the organizers of the inspection system of any technical features connected with the existing processes which would be likely to lead to the disclosure of illicit plants. They would, however, carry out a complete check on the distribution of essential raw materials from known sources of supply and on any active materials produced by, or extracted from known plants.

It is clear that a large number of men and women would have to be employed, but the number would be small in comparison with the numbers at present employed on civil police duties. Only a small fraction of these men need be skilled scientists.

It is necessary to ensure that the task of the inspectors should be made as simple as possible. To bring this about the recommendations made in the Acheson Report referred to above, offer a useful starting point. This report suggests that all activities associated with the production of atomic energy should be classified into "dangerous" activities—carried out exclusively by the United Nations Atomic Energy Commission—and "safe" activities—carried out by national or private bodies under license to United Nations Ato
Energy Commission.

The dividing line between "safe"
"dangerous" categories would need to
defined with great care and be capabl
re-definition from time to time to allow
the possibility of new developments.

It is suggested in the report that
processes involving the mining of uran
and thorium ores and the productio
"denatured" fissionable material woul
classified as dangerous. Small scale
search activities using "denatured" fiss
able material would certainly be class
as safe.

The definition of legal and illegal
tivities along the lines such as these sh
go a long way toward simplifying
tasks of inspection.

PART IV

We have stressed the importance of
tablishing international confidence a
result of a working system of inspect
and in this connection the free mover
and exchange of scientific personnel
very important factor. We believe
this single measure would go a long
towards relieving the present difficul
There is no doubt that scientists of
nations will collaborate if they are
mitted by their governments to do so
might be argued that full internati
collaboration of scientists existed be
the last war and did not prevent it, b
must be borne in mind that as a resu
recent developments, and of the dev
ment of atomic energy in particular,
entists now have a clearer realizatio
their responsibilities and easier acce
their governments, and if they were
mitted to associate they would be ab
contribute more to international u
standing than they could do in the
We wish, therefore, to urge very str
immediate measures to restore and
courage the free exchange of scientis

CONCLUSION

In conclusion we wish to pledge
active support of the signatories of
present statement to a scheme simil
the one recommended by us. We w
again point out that this line of appr
is similar in principle to that embodi
the report of the Acheson Committe
though that report represents a much
comprehensive study of the whole pro

We, therefore, wish to go on record
in support of the recommendations
in the Acheson report and to urge o
United Nations Atomic Energy Com
sion the necessity for the adoption of
control mechanism based on them.

It is our conviction that practicall
scientists in the world will likewis
ready to do their utmost to help in wo
out the details of and in impleme
such a scheme.

he Application of Isotopes to Biology

. . . . Martin D. Kamen

NTRODUCTION

ecent spectacular advances in the pro- ion and separation of isotopes can be ected to have a pronounced impact on biological sciences. It is the purpose of article to present in a general way nature of researches made possible by ent developments in nuclear physics so far as is possible in the space tted, to elaborate with specific exam- the manner in which the basic data of ogy may be enriched and expanded.

he central feature in the methodology e discussed is the *"labelling" of various ents* involved in metabolism. The fact all chemical elements found in nature ist of isotopic mixtures which always the same composition despite wide rsity in source materials and chemical tment employed, renders possible the aration of these "labelled" or "tracer" ples. It is necessary only to change ficially the isotopic composition of a n element to obtain a sample which can istinguished from any ordinary sample he same element. As an illustration one cite the important case of carbon h in the natural state consists of two opes with masses 12 and 13, the latter ys being present in an abundance of roximately 1.06 per cent. Radioactive on isotopes of mass 11 and mass 14 ot exist in nature but can be produced various nuclear reactions in the cyclo- or the uranium pile. A sample of cer" carbon results when ordinary car- either is enriched with the rare stable isotope, or provided with a small unt of the radioactive isotopes C^{11} or Wherever the extra isotope is found , it shows where the carbon went as hole.

hen the tracer used is a stable isotope, isotopic analysis of samples is carried with a *mass spectrometer* in which opes of different mass are separated by zation, acceleration in an electric field deflection by a magnet: The heavier atom, the less strongly it is deflected its path. Various highly sensitive cting devices (Geiger-Müller counters, rometers, electroscopes) are available determination of radioactive tracer pes since every one of them emits its characteristic radiation. Very pos- , one of the foremost contributions of atomic bomb project to the proper oitation of tracer techniques will turn o be the development of rugged, sensi- assay apparatus representing a con- rable improvement on instrumentation available.

2. BIOCHEMICAL APPLICATIONS

At the biochemical level, the biologist is interested in questions associated in what is rather arbitrary called "intermediary metabolism." The fate of a particular molecule, such as glucose, in the metabolic process and the manner in which the component atomic groupings in such a molecule are used as energy sources and structural materials, are problems which the biochemist must solve by experiments with cells, extracts or pure reagents in the test tube. From such knowledge, obtained by the biochemist, the physiologist is enabled to undertake research into the manner in which metabolic reactions are organized into the overall cell economy, so that differentiation and growth proceed within the proper limits.

Progress in the understanding of chemical mechanisms involved in metabolism has advanced spasmodically and at an unsatisfactory rate because except in rare instances no direct experimental approach to intermediary metabolism was possible without the basic ability to discern the fate of a given atom or atomic grouping once it had disappeared into the metabolic "pool"—for example, after it has been consumed and digested by an animal. Thus, the carbon of an ingested sugar molecule could not be distinguished from the previously present cellular carbon, nor could there be made a further distinction as to which of the half dozen carbon atoms present in each sugar molecule were incorporated into protein or glycogen, and which went into excretory material and how rapidly this incorporation or excretion took place. In principle such difficulties disappear when it is possible to label at will whichever carbon in the substrate fed is of interest. Similar considerations hold of course for other body elements such as nitrogen, hydrogen, phosphorus, oxygen, etc.

The use of the tracer technique in the investigation of intermediary metabolism can be illustrated by a research in the fermentation of glucose by the microorganism *Clostridium thermo-aceticum* (Barker and Kamen). The net result of this fermentation is represented by the breaking of a molecule of glucose ($C_6H_{12}O_6$) into three molecules of acetic acid ($3CH_3$-$COOH$). Such a complete conversion of sugar into acetic acid is striking since usually, the fermentation of a molecule of a sugar produces at least one molecule of carbon dioxide (CO_2) for every molecule of a "two-carbon compound," such as acetic acid or alcohol (C_2H_5OH). By adding isotopically "labelled" CO_2 to the substrate (glucose) and allowing fermentation by *Clostridium thermo-aceticum* to proceed, it is a simple matter to show that in this fermentation, too, the process first leads to the liberation of carbon dioxide, but that in a second step, carbon dioxide is reabsorbed and reduced to acetic acid. This is shown by the fact that one-third of the carbon in the acetic acid produced is found to be "labelled," although no labelled carbon was contained in the glucose used. To explain this, one has to assume that glucose (non-labelled) was first converted into two thirds acetic acid (non-labelled) and one third carbon dioxide (non-labelled); the non-labelled carbon dioxide then underwent mixing with the large excess of labelled carbon dioxide provided, and the product of mixing (practically 100% labelled) then was converted to acetic acid (labelled). The application of tracers has thus revealed that a third of the acetic acid produced in the fermentation by this bacterium arises from carbon dioxide and not from sugar—an important feature which would otherwise have remained hidden. The "co-utilization" of carbon dioxide in this biochemical reaction is of great interest, since it establishes a pattern by which the allegedly "inert" carbon dioxide can often be involved in biochemical syntheses in bacteria and animals. (Until recently, the capacity of using carbon dioxide for organic synthesis was considered as a prerogative of green plants).

The hypothesis that a particular compound occurs as a fleeting intermediate in a complex biochemical process can often be established by adding a sample of this compound (non-labelled) and allowing the metabolism of a labelled substrate to occur. If the hypothesis is correct, re-extraction of the added compound will result in finding it labelled, because the "labelled" intermediate produced in the metabolic process, will have mixed with it before being consumed in the next step of the reaction. Thus, in mammalian liver, fatty acids are observed to be converted to acetoacetate. This is not observed to be the case in kidney. The possibility that acetoacetate is actually formed in kidney but is further metabolized too rapidly to be detected by ordinary means was investigated by Medes, Weinhouse and Floyd by means of isotopically-labelled carbon. They found proof that acetoacetate is, indeed, formed in kidney as in liver.

The foregoing examples illustrate a general technique which can be advantageously applied to many formidable and in many

cases hitherto insoluble problems of detection and analysis. It is possible not only to *detect extremely small quantities* of biological intermediates by appropriate extension of isotopic dilution techniques, but this method can also be developed as a powerful aid in *quantitative analysis*. Thus, Rittenberg and his associates have used isotope dilution techniques to resolve the formidable difficulties present in analysis of products of protein decomposition. Proteins, when hydrolyzed, (decomposed by heating in water) yield a mixture of amino acids varying in number up to 20 or more. For few of these important compounds are any specific chemical reagents available. To determine the amount of each amino acid produced, one must separate it completely in a pure state by some fractionation procedure. Quantitative separation and purity are usually contradictory requirements. This difficulty can be obviated by use of an isotopic dilution technique. Suppose one desires to estimate glycine—a common amino acid—in a certain protein. A known amount of glycine, containing labelled carbon, is added to the mixture obtained by hydrolysis of the protein and, after allowing time for equilibration with the unlabelled glycine already present in the mixture, the added compound is isolated again and purified. The analysis of the isotopic composition of this re-extracted glycine is sufficient to determine how much glycine was present in the mixture. For example, if we added 1 g. labelled glycine, and found that after re-extraction, the glycine was only 50% labelled, this proves that the mixture contained 1 g. non-labelled glycine. Only a small sample is required for isotopic analysis so that large losses in re-extraction and purification can be tolerated. Nor is far-reaching purification of the sample required.

In another direction, the isotope technique can be used in conjunction with other physico-chemical procedures to establish the physico-chemical characteristics of biological substances under conditions where ordinary techniques cannot be applied. Thus, intermediates formed from labelled carbon dioxide in the process of photosynthesis, although of unknown chemical composition, have been subjected to centrifugation and diffusion procedures using the labelled isotope as an indicator for determination of sedimentation and diffusion constants. (Ruben and Kamen) From such measurements it has been possible to infer that the molecular weight of the first molecules formed from carbon dioxide in photosynthesis is high (over 1000), thus excluding most mechanisms for this process suggested in the past since these invoked small molecules like formaldehyde, oxalic acid, etc.

This cursory discussion of the biochemical applications is obviously far from complete. To adequately discuss the applications made to date would require a large text. Notable contributions have been made in carbohydrate and protein metabolism, in fat synthesis, photosynthesis, assimilation of carbon dioxide, etc., in spite of a minimal supply of isotopic material. With the emergence of the uranium pile as a tremendously powerful neutron source, it can be predicted that the availability of such important tracers as C^{14}, H^3, P^{32}, S^{35}, etc., will be increased many orders of magnitude. Thus, we can expect a much more extensive exploitation of tracer techniques in biochemistry than that hitherto possible.

3. PHYSIOLOGICAL APPLICATIONS

The discussion has centered so far around the application of tracer isotopes at the *biochemical* level. In this section we will consider researches concerned with the interaction of cellular constituents at the *physiological* level and the role indicated for the tracer technique in such researches.

In studying the relation between living cells and their environment one is confronted immediately with the processes grouped under the term *permeability*—meaning the rate at which metabolites and in particular mineral constituents, penetrate through the walls of living cells. If as a specific case, one considers the entry of potassium and sodium into cells there arises a vexing problem: If cells are immersed in a solution containing potassium and sodium ions, potassium is concentrated preferentially inside the cell whereas sodium is not. To explain this, one could assume that the cell wall is a "semipermeable" membrane which exhibits "selective" permeability for potassium; in other words one could postulate a mechanism which permits potassium but not sodium ion to pass through the wall. It can be shown, however, that no strictly physical force can be generated at the cell boundary to permit such selectivity. As an alternative, one can imagine a process in which the two ions penetrate equally easily through the wall, but potassium is bound preferentially in some organic linkage inside the cell and sodium is not. This hypothesis assumes that the cell walls are permeable to both ions, but that only potassium accumulates inside because it enters into a metabolic process. A direct test of the two alternative hypotheses is made possible by the use of labelling technique. From studies of penetration of radio-active sodium and potassium into cells (Cohn, Fenn, Bruess and others), it was concluded that no selective permeability is involved, since both kinds of ions actually were shown to enter the cell with about equal ease. It is thus confirmed that the mechanism of accumulation of potassium inside the cells must be a "chemica[l]" one.

The study of absorption, excretion a[nd] distribution of "trace" elements such [as] cobalt, zinc, copper, etc., (very small qua[n]tities of which are known to be essenti[al] for the survival of organisms), in vario[us] organs, practically demands the use of t[he] radioactive tracer technique because of t[he] extremely minute quantities of such el[e]ments which must be assayed. Here aga[in] many interesting results have been r[e]ported, a description of which must [be] foregone for lack of space.

Of fundamental interest to physiologis[ts] is the *establishment of biological mec[h]anisms postulated from cell extract wo[rk] of the biochemist.* A powerful tool f[or] such investigations is provided by t[he] tracer method since by the use of labell[ed] atoms it becomes possible to follow t[he] tranfer of atomic groupings from one cell[u]lar fraction to another under physiologic[al] conditions and thus to check inferenc[es] drawn from researches conducted on c[ell] extracts. As an example one may ci[te] recent studies on the phosphate bindi[ng] mechanisms in yeast cells. Spiegelman h[as] shown that yeast cells which usually fe[r]ment glucose, but not galactose can acqui[re] the ability to ferment galactose if inc[u]bated with this sugar in the presence of [a] minimal quantity of glucose. In the proce[ss] of this "adaptation" to galactose a ne[w] enzyme is formed, which transforms gala[c]tose phosphate (formed as the first inte[r]mediate) to glucose phosphate which c[an] be fermented by the enzymes present pr[e]viously. It is also found that in the pre[s]ence of certain agents such as sodiu[m] azide or dinitrophenol, adaptation does n[ot] occur. To elucidate this interesting o[b]servation one may conveniently invoke [the] tracer procedure, using radiophosphor[us] to study changes in phosphate metaboli[sm] brought about by these inhibiting agen[ts]. If yeast cells are suspended in a gluc[ose] medium containing labelled phosphate [in] the presence of azide, it is found th[at] although the rate of fermentation of gl[u]cose remains essentially unaltered, t[he] turnover of phosphate (entry of rad[io]active phosphorus into the cells) is le[ss] than two per cent of that found in t[he] absence of azide. When all cellular ph[os]phorus-containing components of yeast a[re] labelled it is found that the azide acts [to] prevent migration of phosphate grou[ps] from the nucleoprotein fraction. On t[he] basis of these and other observations, w[ith] tracer carbon and nitrogen it should [be] possible to supply useful data not only i[n] the understanding of specific proble[ms] such as adaptation to galactose, but i[n] the solution of many fundamental pr[ob]lems, e.g.:

(1) The mode of formation of enzym[es] in cells.

(2) Mechanisms for maintenance [of]

normal enzyme constitution.

3) Mechanism for alteration of enzyme constitution during adaptive processes as well as onset and maintenance of abnormal metabolic processes.

iously, the elucidation of such prob-s is of the utmost importance in de-ping a rational basis for therapy of abolic disturbances which result in ormalities such as leukemia, cancer, etc.

urning to yet another phase of tracer k at the physiological level there may mentioned the *extension of histochem- techniques* by use of radioactive tracer ecules. Histochemical studies seek to rmine distribution of reactive biologi- groupings either within the cell, within regates of cells or in the intact anism. Usually this is accomplished by ning techniques. The method can be e widely developed by the exploitation ne photographic effect of the radiations tted from radioactive tracer atoms l to label specific molecules. The ex-mental procedure involves preparation tissue section after dosage with the lled molecules. This is followed by luction of the photographic image of radioactivity distribution by placing section in close contact with a photo-phic film. Alternatively, activity can napped with the use of a slit scanner Geiger counter if more sensitivity is ired. When a photographic image is lved this method is termed the "radio-graph" technique. It has a long his- in radiochemistry having been used the study of precipitation processes in tals early in the century. The move-t of mineral metabolites in plants has studied in this manner (Stout, Gus-on). Obvious applications of interest ne clinician arise from the existence of a technique. The localization of iodine ormal and abnormal thyroid has been ied (Means, Hamilton and Soley) and ain limited applications in therapy and nosis already indicated.

ne extension of this technique to the y of metabolite distribution in single shows promise of creating a new field istochemistry. The ultimate limit in ution is probably not quite that ned in the electron microscope since rder to obtain sufficient activity in oscopic areas for photographic pur-s enormous activities must be admin-ed to the whole cell with consequent ological manifestations. Furthermore, grain of the photographic emulsion es out detail. It is not possible at ent to focus the radiations and mag- the radio-image by use of an instru- such as the electron microscope be-e of the continuous beta-ray energy rum emitted. It is possible that with hydrogen which has a very low energy radiation this difficulty can be circumvented. A possible application here could be the labelling of carcinogens (cancer-producing chemicals) and other interesting molecules with radiohydrogen. The localization of such molecules in various areas of the organism or inside single cells might be determinable with an "auto-electron microscope" technique of this type.

Only passing mention of possibilities in the field of radiobiology and radiotherapy is possible within the scope of this article. It is apparent that with a variety of radiations carried by specific chemical elements, the radiobiologist is enabled to greatly extend studies on the relation of radiations to cell function, particularly in regard to the effects attendant on localization of radiation in specific portions of the cell. All of the biochemical and physiological studies on cell function must be correlated with the mode of action of radiations to which a cell is exposed. Little has been done in this field because of our scanty knowledge of intermediary metabolism. To the radiotherapist the possibility of localization of any desired radiation in any desired portion of the organism under treatment is the main objective. Here again potentialities are great but experimental progress is limited by lack of trained personnel and isotopic material. One may mention the use of radio-iodine, radio-phosphorus, radio-sodium, and radio-manganese as agents in improved therapeutic procedures for leukemia, Graves' disease, polycythemia vera and a variety of granulomatous and lymphomatous conditions.

The foregoing, in all too brief fashion, indicates some potentialities of the tracer technique in the field of biology, fundamental and applied. It is quite evident that the armamentarium of the biologist is vastly enhanced with this offshoot of nuclear physics. It is not surprising that so eminent a physiologist as A. V. Hill has characterized the tracer technique as the most significant advance to occur in biological instrumentation since the advent of the microscope.

UN ATOMIC ENERGY COMMISSION CALLED TOGETHER

The UN Atomic Energy Commission is to hold its first, open meeting on June 14. The American delegation, headed by Bernard Baruch, who has now assembled a considerable staff of technical and scientific advisers headed by Prof. Tolman, is working on a declaration of American policy, which will have to be approved by State Department and President before it can be presented to the Commission. If this policy paper is not in final form by June 14, the Commission may have to adjourn for a time after its opening meeting.

Secretary General Trygve Lie, in a letter dated June 3, addressed to the commission's members, emphasized that each member should be represented by the delegate whose name had previously been forwarded to him by his respective Government. Because of the limited accommodations at the council table, he requested that each delegate be accompanied by not more than four advisers or associates.

The first item on the agenda for the opening meeting will be an address by the Secretary General, to be followed by his proposal of a provisional chairman, remarks by the provisional chairman and the adoption of the provisional agenda. Other items on the agenda are the consideration and adoption of the principles governing the chairmanship of the commission, the selection of the chairman, consideration of rules of procedure and members' credentials and the appointment of a committee to deal with rules of procedure.

THE McMAHON COMMITTEE HEARINGS ON INTERNATIONAL CONTROL DELAYED

The Senate Special Committee on Atomic Energy had planned to start new hearings, this time on international aspects of the atomic energy problem, soon after the McMahon bill was reported out to the floor. Two months have passed, but the hearings have not been taken up. The Washington correspondent of the Christian Science Monitor, William H. Stringer, reported on May 23, that the hearings are being delayed by the State Department and the White House because of possible interference with the development of plans by Mr. Baruch and his group. According to Mr. Stringer, Mr. Baruch "does not want the applecart to be upset by front-paged hearings while he is conducting delicate negotiations with Russia, Britain and other powers."

McMAHON BILL PASSES THE SENATE

In a sudden burst of action, the Senate on Saturday, June 1, passed by voice vote and almost without debate, the McMahon bill for national control of atomic energy, practically in the form in which it was reported in issue No. 9 of this Bulletin. All effort must now be concentrated on preventing the bill from being stalled or disfigured in the House of Representatives. It first goes to the Military Affairs Committee, whose Chairman, Rep. Andrew May (Kentucky) apparently would like to amend the McMahon bill until it looks like the old May-Johnson bill. The Committees on Civilian Control of Atomic Energy and the other organizations which have been so succesful in bringing the McMahon bill through the Senate, have one more task cut out for them—to pilot the bill through the House before the summer recess.

Acheson Report and Chicago Draft Convention

. . . .*E. Rabinowit*

In issue No. 8 of the "Bulletin," we printed a condensation of the Lilienthal-Acheson Report on international control of atomic energy and a preliminary versin of a draft convention on the same subject, prepared at Chicago by a group of scientists and social scientists under the leadership of Prof. Quincy Wright. This Draft has since been slightly revised to give a clearer formulation of the basic policies, particularly where these policies differed somewhat from those recommended in the Lilienthal-Acheson Report. Since the complete Draft cannot be reprinted here, we must refer the reader to its forthcoming publication in pamphlet form; in the present article, an analysis is attempted of the similarities and differences between the State Department report and the Chicago draft in its revised form.

The "Draft for a Convention on Atomic Energy" was prepared quite independently of the report of the Lilienthal Board. It is therefore of some significance that in major outlines, the two plans are largely in accord. This can be taken as an indication of the extent to which the actual facts of the situation point to definite conclusions and make alternative solutions difficult if not impossible.

The similarity of the two plans is largely due to the fact that both are based on the same two fundamental premises:

(1) No national or international organization can be permitted to produce or own atomic bombs (except perhaps for purposes of scientific experimentation);

(2) Activities such as large-scale production of fissionable materials, which can easily be converted to the production of atomic bombs, must be taken out of the hands of national or private operators, and made a monopoly of an international agency.

There seems to be no illusions about the fact that if war is ever again allowed to break out, atomic bombs will ultimately be used, even if they were outlawed and non-existent before the beginning of the hostilities. The argument for eliminating the bombs by international agreement even without the establishment of a world community in which wars are impossible, rests therefore on the influence which the existence of atomic weapons in peace will have on the probability of another war.

That uncontrolled possession of atomic bombs by national states will enhance international friction and may become the main psychological cause of a new war, is a widely held opinion. Being a political prognostication, it is difficult to prove. Those who see the future differently and believe that the possession of atomic bombs by all major nations will have a sobering influence and serve as a deterrent to war, have no reason to seek international control of atomic energy. Inversely, all who feel that international control *is* necessary, *eo ipso* acknowledge that they consider possession of atomic bombs by separate nations as a dangerous threat to peace.

This point of view is shared by the authors of the State Department Report as well as by those of the Chicago Draft Convention.

If it is admitted that atomic bombs shall not be allowed in uncontrolled possession of individual nations, the question arises whether they should be outlawed altogether, or given exclusively to an international armed force (or perhaps distributed to member nations as trustees of the UN, according to some pre-established ratio). Arguments against any such plan were summarized by Prof. E. Shils in an article in No. 9 of the Bulletin. Both the Lilienthal report and the Chicago Draft Convention are based on the postulate that atomic bombs must be outlawed for *all* purposes—as international police or sanction weapons not less than as weapons of "ordinary" warfare between nations.

* * *

Some recently suggested atomic energy control plans have been limited to the prohibition of the possession of atomic weapons by individual nations, supported by effective inspection; in other words, they left the production of fissionable materials (from which atomic bombs are made) entirely in private or national hands. Every nation was to be permitted to produce as much plutonium or U235 as it sees fit, provided the products all went into peacetime devices such as power plants, and none was used for actual bomb production. However, as far as the effect on international relationships is concerned, uncontrolled national production of fissionable materials is not much different from uncontrolled production of bombs, since the assembly of fissionable materials into bombs is a minor technical operation compared to the production of these materials. Therefore, both the State Department Report and the Chicago Draft Convention add to the prohibition of bombs, a second prohibitin—that of national or private production of fissionable materials.

* * *

Starting with the two common basic postulates—that no atomic weapons should be permitted to anybody, and that activities which can easily lead to production of such weapons shall not be permitted to national or private operators—the two plans develop schemes which, despite t general similarity, differ to a certain tent in administrative structure, in exact delimitation of international national activities, and the contempla sequence of developments which are lead to the final stable state. In the *ministrative* sphere; the Lilienthal Bo proposes a single agency—the Atomic velopment Authority, or ADA, combin policy-making, developmental, and cont ling and inspectional activities. agency apparently is planned to be la ly autonomous in its relation to the The Chicago Draft, on the other hand, tempts to fit the international Atomic ergy Agencies into the UN structure suggests three separate bodies—one policy-making, one for research and de opment, and one for control and ins tion. Acknowledging that policy decis in the field of atomic energy—such whether private and national atomic p installations shall be permitted, rights of control and inspection shal conceded by the individual nations, wh er national quotas for the productio fissionable materials shall be establis and so on—are eminently political sions, the authors of the Draft Con tion believed that it would be impract under the existing conditions, to dele the making of these decisions to an ag not closely related to the Security Co of the UN. The Draft therefore sug that the atomic policy planning sha the function of a permanent Atomic E gy Commission of the UN, set up u the Security Council in the same wa the present preparatory Atomic En Commission—i.e. consisting of deleg appointed by the governments of the tions members of the Security Co (plus Canada when it is not membe the Council). On the other hand, the rying out of the policies laid out by Atomic Energy Commission, and ado by the Security Council, and the co of compliance of individual nations these policies, is given, in the Draft, the hands of an Administrative Com sion and an Inspection Commission, established on the same basis as the I national Court of Justice, i.e. consistir individuals nominated by single nat but elected jointly by the Security Co and the General Assembly of the UN. idea is to give the administration an spection into the hands of bodies enj the highest possible reputation for im tiality—agencies which will owe pri loyalty to the UN as a whole, rather to the individual member states.

* * *

The final *scope of internationa*

ic energy activities* is somewhat nar-r in certain areas and wider in others he Draft Convention than in the State artment report.

narrower field of international oper-n is provided in the Draft in the field *ining*, where only the main uranium thorium mines, (i.e. those mines which provide the raw materials for the e-scale production of fissionable mate-) are to be operated by the Interna-l Agency. The mines which can pro-only small amounts of uranium or um (e.g. as by-products of vanadium ng) are to be licensed for private or nal operation, subject to inspection heck whether any uranium and thori-actually are mined and refined, and if is the case, to ensure the delivery of e products to authorized purchasers.

e large-scale *production of fissionable rials* is, in both plans, completely opolized by the international agency.

rge-scale *atomic power production* is ed somewhat differently in form, but in substance. The State Department professes explicitly the belief that turing, plus enforcement of designs h will make the utilization of power s for the production of additional nable material impossible, plus occa-l inspection of these plants by the ts of the ADA, will permit the classi-on of power production as a "safe" ity. The report acknowledges, howev-hat this belief is by no means a cer-y, and that the whole question will to be re-examined more closely later. ints out that time for re-examination be available because several years will e before atomic power production on basis of accumulated reserves of fis-ble materials, will become a practical em.

e Draft Convention makes no similar istic predictions, but simply states the Atomic Energy Commission will to decide sooner or later whether r production can be licensed to nation-private operators, or whether it will to become a monopoly of the interna-l agency.

this connection, a misunderstanding d be corrected. It seems to be widely ved that prior to the Lilienthal board t, the possibility of denaturing fis-ble materials was not taken into con-ation in the discussion of internation-ntrol. The perusal of the "Report to Secretary of War" of June 11, 1945, nted in No. 10 of the Bulletin of ic Scientists, shows that even at that date, scientists were aware of the bility of denaturing. This possibility been in their minds when they first osed international control of atomic y, more than a year ago. However, ated in many authoritative comments e Lilienthal report (cf. Bulletin No. 8, p. 10 and No. 9, p. 11) denaturing is by no means a panacea, but merely one of several safeguards that taken together *may* make atomic power production by private or national agencies "safe." The second of these safeguards has received much less attention — the limitation of power plants in private or national operation to designs which do not permit one to obtain new fissionable materials as by-products of power production. The economical and technical possibility of enforcing such designs is a problem which will have to be faced together with the problem of the practical feasibility and effectiveness of denaturing.

* * *

Control and inspection problems are treated in the Lilienthal report in a somewhat summary fashion. The main stress is laid on the reduction of inspection to "tolerable" dimensions, and its intertwining with the constructive functions of the ADA. It is acknowledged in the Report that inspection of a more "police-like" type cannot be entirely avoided, but no detailed analysis of the scope of the required inspectional activities is attempted, and no special administrative set-up is provided to take care of these activities.

The main type of "policing" which will be required if the State Department board plan is carried out, is the *inspection of mines*, intended to make sure that no uranium or thorium are produced outside the ADA-owned or operated mines. No details are given in the report as to how the certainty that no clandestine mining is taking place will be achieved, except for the suggestion of a world-wide prospecting for radioactive minerals under the auspices of the ADA, which presumably shall produce a complete "inventory" of world resources of radioactive raw materials.

The Lilienthal Board Report apparently assumes that raw material control will be so reliable as to make regular inspection for clandestine *factories* of fissionable materials (isotope separation plants and plutonium production piles) unnecessary. It consequently makes no provision for such inspection as a normal function of the ADA, but merely gives the ADA the right to appeal to the International Court for permission to inspect any activity which might be brought to its attention and which it suspects to be "dangerous" —provided a *prima facie* case can be established for this suspicion.

Inspection is again considered by the Lilienthal report as necessary in the "third stage" of the atomic energy development—the private power production on the basis of denatured materials. In this stage, security must be provided against clandestine conversion of such power plants to the production of fissionable materials, as well as against diversion of denatured materials to clandestine isotope separation plants for reconversion into explosives. It is suggested in the report that this inspection can be achieved by occasional visits of ADA-engineers, who will simultaneously act as technical advisors to the power plant operators.

The conditions envisaged in the Report are summarized in the following scheme:

	Inspection in Lilienthal	Report
Stage 1	Production of Raw Materials	Complete, fool-proof system of control and inspection must be devised
Stage 2	Production of Fissionable Materials	No inspection except after appeal to International Court for warrant with prima facie evidence for evasion
Stage 3	Power Production from Denatured Materials	Inspection by ADA engineers incidental to their advisory activities

The main doubts which exist among scientists as to the sufficiency of safeguards provided in the Lilienthal report pertain to the limitation of inspection activities to those shown in the table. (We refer here only to the safeguards which will operate after the plan has become fully operative. The transitional period poses many other problems of safeguarding security; some of which will be discussed below).

There seems to be widespread agreement with the thesis that raw materials control is the easiest and therefore most important method of achieving a considerable degree of control over the whole atomic energy situation. The methods of mining control have been analyzed in several memoranda reprinted in the Bulletin (cf. issues 2, 5 and 6). The potential importance of a periodic *aerial survey* of a considerable part of the earth's surface was particularly emphasized in an article by Prof. Jerome Fisher (cf. Bulletin No. 5). This kind of inspection appears to be very efficient in detecting illicit mining, and could be put into operation with a minimum of personnel and equipment, and without intolerable interference with national sovereignities in the air.

However, while there is general agreement on the importance of mining controls, there is a divergence of opinion as to whether the degree of safety achieved by this method *alone* could be sufficient to dispense with any general provisions for the inspection of industrial plants and laboratories. Many feel that the latter is necessary as a "second line of defense," to make evasion of mining controls less tempting. The Chicago Draft Convention provides for an Inspection Commission, which should have the right to send its inspectors not only into mines and refineries, but also into industrial buildings or installations of specified types in every country. These inspectors are to be recruited from all countries and work in international teams. Prof. Teller* suggests

that one should rely even more heavily on inspection. His proposal requires that each country shall have the right to send *any number* of its agents as investigators into any country, provided (a) that the country which sends the agents is prepared to pay the costs and (b) that the agents are found acceptable to the ADA, which enrolls them as its inspectors, and gives them its protection. Prof. Teller apparently thinks that the presence of a large number of freely circulating, internationally protected foreign agents will make evasion too risky even if these agents are *not* given an explicit right of entry into buildings, plants and laboratories. Whether such a general breakdown of barriers to free travel between individual countries would be more effective than specific inspectional activities by a much smaller number of ADA agents with explicit powers of entry and investigation, is a question to which different answers will be given. In practice, the choice between "police-like" inspection by a limited number of UN inspectors and the "flood of publicity" method proposed by Dr. Teller, will have to depend on which procedure is more likely to prove acceptable to all nations, rather than which would theoretically provide a higher degree of protection. The authors of the Draft felt that a nation might be less reluctant to admit a limited number of authorized UN inspectors, than to throw its doors open to a large number of agents of all other nations, even if all these agents were operating under the sponsorship of a single international agency.

* * *

The *steps by which the complete operation of the respective plans is to be approached* are considered somewhat differently in the two documents. The final state envisaged must in any case be one of *equality* of all major nations—since obviously a plan which fails to point to such equality will have no chance of being accepted by other nations. The Lilienthal Report proposes to achieve equality by ADA-sponsored and assisted development of atomic energy projects everywhere, thus gradually bringing other countries abreast of the USA, (whose own plants and laboratories are, in the meantime, to continue full blast, with gradual transfer of control over these American installations to the ADA). Only the actual production of bombs is to be discontinued in America, at an unspecified moment, when this step will be held opportune by President and Congress. This procedure will ensure American superiority in the case of breakdown of the ADA at any moment prior to the achievement of the final state of equality.

The drafters of the Chicago Convention were afraid that agreement on this basis might be very difficult to achieve within a short time, since it will require decisions on such points as the "strategic" distribution of capacity for the production of fissionable materials between various countries, (which will involve the adoption of some 5-5-3 or similar ratio between major powers), the order in which the plants are to be built in different countries, etc. For this reason, the Draft Convention proposes to establish *first*, a temporary state of equality by a general *moratorium* on the large-scale production of fissionable materials, to go into operation as the first step of international agreement. During this moratorium, the American advantage will be maintained by the fact of continued existence of American plants, even while they will only be maintained in standby condition under the control of the Atomic Energy Commission of the UN.

* * *

The Lilienthal report devotes considerable space to the analysis of several consecutive steps by which the release of information, now in exclusive American possession, is to be accomplished. These steps are determined by the successive undertaking of the several constructive activities of the ADA (first uranium mining, then nuclear research, then world-wide production of fissionable materials, etc.) and in each step, only as much information is to be disclosed by the U.S. as is necessary to permit the relevant part of the program to be administered intelligently. The final step will be the disclosure of the secrets of the bomb construction, which will become necessary only when the ADA decides to undertake research into the application of nuclear energy for explosives.

This stepwise mechanism was devised especially to satisfy the widespread demand in this country for not disclosing any information without adequate safeguards and compensations from the other side.

The Chicago Draft Convention envisages no division of the plan into stages apart from the preliminary period of moratorium on large-scale production. As far as information is concerned, it suggests an agreement on general release of all information as an integral part of the convention, to be implemented immediately when the convention comes into operation—that means, without awaiting the end of the "moratorium" and the beginning of the construction of large-scale installations in various countries.

The ban on secrecy is in this case correlated with the coming into effect of the control and inspection provisions, rather than with the beginning of certain positive, constructive activities. The reason that an attempt to bargain our knowled of atomic energy facts for an agreeme providing for effective control and insp tion may be a more realistic approa than the suggestion that we are going release our knowledge in portions whene er the ADA will be so far in its operatio as to need them. A similar point of vi is brought to its extreme expression Dr. Teller's memorandum, which sugge a complete publication of all our know edge in this field in exchange for the p mission to send any number of agents may desire (and the ADA approve) i any country.

However advantageous the procedu of gradual disclosure of information m appear, it may be argued that the most can obtain in exchange for this inform tion is what other nations will be willi to pay for it *now*. We already have wea ened our bargaining position by a yea delay, during which first the Smyth rep was published, and then much of the s entific information existing on the Proj was made eligible for de-classificati Other nations are now accumulating th own research results. The longer we wa the more of our original "secrets" w become generally known, and the more o er nations will value their own new acquired "secrets." Furthermore, as poi ed out by Dr. Teller, disclosure of tech cal "secrets" is only a first step towa repetition of a technological achieveme If we disclose how the Hanford pile constructed or even how the Nagas bomb functions, this does not mean t everybody will immediately be able build a similar pile and detonate a si lar bomb. Others will still have to acqu all the scientific and industrial experie which we have at present. Trained sci tific personnel and industrial know-h are as large or even larger a part of present advantage as are the secret bl prints. These advantages could be rapi overcome only by training foreign pers nel in our laboratories and plants. T we will have to do when the ADA (or Administrative Commission, according the Draft Convention) will begin its wo wide operations in the production fie but this may not occur for several yea The publication of scientific and tech logical facts on the other hand could timed with the inauguration of control a inspection activities (such as mining c trol, aerial survey and roving inspect of plants and laboratories), immedia after the ratification of the convention.

*See article on page 5.

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he ADA and the Veto Power

. . . . **David R. Inglis**

Ve scientists must be quick to recognize political naivete and try to stop short demanding the unattainable, but we t be equally careful not to fall into common error of judging practicability ly in the light of pre-atomic standards. ny of us have come out of our war erience with a feeling of having shared he process of doing the nearly impos- e and are impatient with public thought ch seems to be fettered by tradition limited by the horizons of past experi- . To us it seems almost obvious that, ope with atomic energy in international tions, methods are needed as drastically as the technical methods employed in loping this energy. Drastic proposals, ever, encounter the obstacle that the hods must be developed and the deci- s must be made by agreement of the les of the world and their political ers, and there is danger that nothing be done in the face of calamity unless onably effective methods can be found do not deviate much from those which be judged in the light of political rience. The State Department Report masterly answer to drastic necessity erms which are politically plausible, it deserves vigorous effort on the part l nations to reach that degree of com- nise and mutual understanding which e may shape it into political and phy- reality.

the difficult task of working out a led plan for the international control tomic energy, there will doubtless be y points where certain groups of na- ls will be tempted to hold back (per- temporarily forgetting the "frightful native") where they will try to in- on some more traditional and less tive solution. This is where it will ably be most useful for scientific ps, and for those who have shared them their feeling of the urgency of situation, to give some rein to their tuosity for the more drastic solution, out a little ahead of the average of c opinion, and to insist that nothing of an effective solution to the prob- s good enough.

discussing the political implications e State Department Report, a study h is obviously still in its infancy and not be too long in growing up, E. A. in the April 15 issue of the "Bulletin e Atomic Scientists" proposed that Atomic Development Authority should ate under the control of the Security cil. This he urged as a matter of cal realism, consistent with the fact the Soviet Union has remained most ant on the question of the veto power, and is supposedly not likely to change this conservative attitude in the short time available for the achievement of international atomic control.

In this question of the veto power, it may reasonably be claimed that an ADA subject to the veto of any single partner would have a very small chance of attaining an equitable distribution of producing plants or indeed any material achievement whatsoever. Rather than suggesting a veto power, we should be insisting that an Atomic Development Authority subject to veto is no authority at all, that an international organization which has in principle authority to prepare fissionable materials so as to keep research alive and keep on the forefront of knowledge (as a protection against surprise) but which is in reality eternally deadlocked over such issues as the distribution of its plants cannot long suppress misuse of atomic energy.

It has been argued on the basis of political experience that the Soviet Union will not join with us in an international enterprise without reserving the veto prerogative. This political experience was gained in fields very different from the control of atomic energy. Quite aside from the question of mutual atomic annihilation, those fields differed from atomic development in lacking any real community of interest. When we had the mutual interest of defeating Germany, there was no talk of veto power. In competing for oil in Iran, there has been no community of interest. But it is proposed now in the State Department Report that we go into a business together, that we and other nations together develop a promising new industry, and incidentally assure ourselves that none of us is going into this dangerous business independently. Here we have community of interest. Our probable willingness to cooperate here should not be judged by our actions in fields where we had no such community of interest.

It may be pointed out that the Soviet custom in running a business is somewhat different from ours—at least in those of our businesses where the board of directors is more than a hollow shell—and that there may be some difficulties in reconciling these differences of custom. In their industries, as well as in many of ours, it is said that the manager is the key man, making decisions for his industry so far as permitted by his government. Because of the prevalent institution of nationality, which is as thoroughly recognized by the Soviet as by ourselves, this key-executive system will not be possible in the ADA. There will have to be a board of directors to make the important decisions. Its actions will have to be limited in such questions as the strategic distribution of plants by the international agreement which sets up the ADA. But not by veto power. It is to be hoped that a statute of limitations can be devised to which the nations including the Soviet Union can agree of their free volition, within which the "board of directors" may be permitted to act effectively by majority agreement, so that some decision may always be made. This hope is bolstered by the expectation that all nations concerned will be aware of the awful alternative to effective international control of atomic power.

Our present efforts should not be directed toward imagining monkey-wrenches that others might want to throw in the machinery, but rather toward influencing our representatives in the Atomic Energy Commission to approach their task in a spirit of sincerely cooperative study, and with a determination that the final result of the compromising must be an ADA that works.

IOWA ACADEMY OF SCIENCES SUPPORTS LILIENTHAL-ACHESON PLAN

The Iowa Academy of Sciences, having a membership of over 600 scientists, has passed on April 20 at its annual business meeting, a resolution stating "We support the Mitchell-Kilgore-Morse-Fulbright resolution calling for international control of atomic energy within the United Nations along lines suggested by the Acheson report." The resolution is recommended for adoption by individual sections.

NEW EXECUTIVE COMMITTEE OF THE ATOMIC SCIENTISTS OF CHICAGO

The six-month tenure of the first Executive Committee having expired, the Atomic Scientists of Chicago recently elected a new Executive Committee. The election was by a mail ballot, in which 170 members participated. The new Committee will consist of nine members (instead of the present seven). They are Profs. T. E. Hogness (until now Chairman of the Advisory Committee), Harrison S. Brown (formerly of Clinton), E. Teller (formerly of Los Alamos), C. Hutchinson, Jr. (formerly of the New York group) and R. Moon, and Drs. A. Jaffey, Maria Mayer, M. Freedman, and A. Novick. The new Committee contains three members of the old one—Moon, Jaffey, and M. Freedman. All other incumbents had asked to be relieved, because of months long neglect of regular work, sleep and family life. According to the amended constitution, the new Committee will have the right to coopt six alternates.

A SOVIET COMMENT ON AMERICAN ATOMIC POLICY

Soviet distrust of the intentions underlying American atomic energy policy is expressed in "Science and Atomic Policy" by M. Rubinstein, in **New Times** (No. 6, March 15, 1946), an authoritative journal of Soviet opinion on foreign affairs printed in Russia and published in Russian, English, French and German.

The author, Mr. Rubinstein, declares that the present American policy regarding atomic energy is under the control of the military and their allies, the industrial monopolists who, together, are hindering the employment of atomic energy for peaceful purposes. These "imperialist circles" are alleged to be continuing unabated "their attempt to utilize the discovery of atomic energy for gambling in foreign affairs, with no scruples at all about their methods." The Bikini Atoll test is treated as an attempt by the U. S. Government to create fear in the world, not of the atomic bomb as such, but of the United States as a possessor of the atomic bomb. The arguments of those who support the Bikini Atoll test as a means of awing mankind into recognition of the gravity of the situation and into acceptance of international control, are characterized contemptuously as "pious" i.e., as hypocritical. The real motivation of the Bikini Atoll test is alleged to be disclosed in the "reactionary jingo press", which talks about protecting American interests "in all parts of the globe right up to the Mediterranean, and of the necessity of taking advantage of the present situation to establish a 'new atomic imperialism', 'atomic dictatorship', etc."

The article accepts implicitly the desirability of international control but it does not discuss it in any detail. The argument for international control is not elaborated, but is supported by an approving reference to the Moscow Agreement of the Foreign Ministers and the creation of the United Nations Atomic Energy Commission. No explicit preference for international collaboration is asserted. It is only implied by juxtaposing "the establishment of international collaboration in the sphere of atomic energy as provided for in the decisions of the Moscow Conference of the three Foreign Ministers and of the Assembly of the U.N.", and the activities of the proponents of the "Japanese System" in the United States who are "brandishing the atomic weapon for purposes which have little in common with peace and the security of the nations."

Mr. Rubinstein adduces as support of his proposition, that "this notorious 'atomic policy' prevents the utilization of atomic energy for peaceful purposes, jeopardizing the developments of science and represents a great peril to mankind", the activity of various scientist groups in the United States. The scientists' arguments stereotyped dogmatism regarding capital- and activities are cited not so much to show that a strong movement exists in the United States in favor of the international control of atomic energy, but rather as evidence of the malevolence of the U. S. Government, whose activities are disapproved by renowned scientists who "protest against utilization of the gigantic progress of the scientific achievement war and for gambling in foreign affai

For those who recognize that the av ance of an atomic war rests on the es lishment of positive and friendly relat with the Soviet Union, this article wit stereotyped dogmatism regarding capi istic imperialists conspiring to make against the Soviet Union, and its lac understanding of the dynamics of pu opinion in democratic states is dishe ening. But in its affirmation of the to adhere to the U.N. resolution establ ing the U.N. Atomic Energy Commiss there is also a source of hope.

LOUIS B. SLOTIN

Atomic scientists mourn the loss of Dr. Louis B. Slotin who died May 30th from the effects of radiation produced in an accident involving fissionable materials. The accident had occured on May 21st. For some time, Slotin had been eager to return to peacetime work. He had planned to accept an Assistant Professorship at the Institute of Biophysics and Radiobiology at the University of Chicago in Fall, but the possession of unique skills obligated him to continue at Los Alamos until the Navy tests were completed.

Though quiet and unassuming, Slotin had led an unusual life. A Canadian, he received a Bachelor's degree in Geology from the University of Winnipeg and a Doctor's degree in Physical Chemistry from the University of London. Slotin was a modern adventurer; he was drawn to wherever there was promise of excitement. At one time he was with the RAF, until the discovery was made that he wore glasses. He was studying in Barcelona when the Spanish civil war developed; he joined the Loyalists and operated an anti-aircraft gun for them.

While passing through Chicago on his way back to Winnipeg from Europe a chance conversation led Slotin to accept a job of a Research Associate in biochemistry, to help construct the cyclotron at the University of Chicago. This served as an introduction to the field of nuclear physics. He contributed to a number of papers in Radiobiology before joining the atomic energy project when it was centralized in Chicago in 1942. Always following the center of activity, Slotin went to Oak Ridge to help with pile development there. When the problems of plutonium production were solved, Slotin moved to Los Alamos to assist in the final problem of constructing an atomic bo

It was Slotin who assembled and de ered the first atomic bomb for the Ala gordo test. The receipt which he recei when he turned this, the first atomic bo over to the Army was one of his m prized possessions. It represented the mination of the whole effort of the M hattan District. Despite his import contribution towards the making of bomb, Slotin was not permitted to go Tinian, the launching point of the Hi shima and the Nagasaki attacks; he still a Canadian citizen, several we short of his final American papers.

Slotin's work was dangerous, and knew it. He had watched the agony one of his men, who died after an ear accident. He felt obligated to conti until someone else could be trained replace him. The danger was implied the very nature of the experiments he chosen to carry out, not in their relat to military applications. Actually, the a dent which caused his death occur during an investigation directed towa peace-time use of atomic energy.

The peace-time development of ato energy will suffer from Slotin's loss. had an intimate, first hand experience w important techniques few others poss He preferred to help others than to w on his own ideas. He was the man in laboratory who was always willing to t the time and lend his skill to any pror ing idea that came up. Those who had pleasure of being associated with Sl loved him for his selflessness, his mod and his helpfulness.

Slotin was 35 years of age and married. His parents came from Wi peg, Canada to be with him at Los Ala when he died.

BULLETIN OF THE ATOMIC SCIENTISTS

EDITORS:

H. H. Goldsmith **E. Rabinowitch**

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[B]ULLETIN of the
[A]TOMIC SCIENTISTS . . .

[V]OL. 2 JULY 1, 1946 Nos. 1 and 2

[T]he American and Russian Proposals . . . .

The first two meetings of the United Nations Commission [on] Atomic Energy have produced two developments of great [im]portance.

In the first meeting, on June 13, the program for world-wide [co]ntrol of atomic energy through an International Atomic De[vel]opment Authority (which was received with widespread [ap]proval as a bold and constructive plan when it was first [su]ggested in the Acheson-Lilienthal report) and of its enforce[me]nt by the elimination of veto power, was presented to the [wo]rld by Bernard Baruch as the official proposal of the Ameri[ca]n government.

In the second meeting on June 19, the representative of [U]SSR, Andrej Gromyko presented an official Soviet proposal [ai]ming at the outlawing of atomic weapons, exchange of atomic [inf]ormation, and creation of a Committee for the study of [me]thods for supervision and enforcement of these covenants.

* * *

Comparison of the Baruch declaration with the Acheson-[Lil]ienthal report shows that while accepting largely the ideas [an]d control mechanisms suggested in this report, Mr. Baruch [ad]ded the statement that the whole plan will be valuable only [if] rapid and efficient sanctions are provided against any vio[lat]or of the agreement. He, therefore, proposed that as far as [san]ctions against nations violating the atomic energy convention [are] concerned, the power of veto be eliminated.

This exemption from the veto power was approved by the [del]egates of Great Britain, Canada, Brazil, China and Mexico, [but] was opposed by Gromyko on behalf of the USSR, and has [sin]ce been criticized in the Russian press as an attempt to [est]ablish an American "atomic world domination." Thus, the [que]stions of sanctions and of the veto power became the first [poi]nt of disagreement in the Atomic Energy Commission—a [con]troversy which may deadlock its deliberations. Since such [a d]eadlock would be tragic, it is essential to approach the veto [pro]visions in their relation to the international control of atomic [ene]rgy as dispassionately as possible.

* * *

[I]n discussing the veto power as it applies [to a]tomic energy, one has to distinguish [betw]een three aspects of the question.

[I]n the *first stage* of international dis[cuss]ions—which we are now entering—[the] methods of international control have [to b]e elaborated by the UN Commission, [app]roved by the Security Council, and put [into] operation by a treaty signed (at [leas]t) by all major nations. Since the [pres]ent attempt is to achieve international [cont]rol of atomic energy by a treaty be[twe]en sovereign nations, and a treaty can[not] be imposed on any one nation, no [maj]ority decisions are possible in this [stag]e. Hence the veto question does not [aris]e.

[T]he *second stage* will be that of the *operation* of the international control. According to the American plan, during this period, an international authority will operate within the territories of all member states, engaging in mining, fabrication, research and inspection activities. These activities will be practically impossible if each single step undertaken by the Authority can be threatened by a possible veto by any one of the major nations. Therefore, the rights of the Authority to operate laboratories and plants, to inspect industrial and research activities, to conduct aerial and other surveys, once defined in the Convention, cannot be subject to veto by individual governments—otherwise the whole Authority will be but a powerless mockery.

In suggesting the abolition of veto, Mr. Baruch referred, however, mainly to the *third* aspect of international control—the procedure in the case of *violation* of the control agreements, and this is where a controversy with USSR is threatening to arise. One may hope that the question of sanctions in the case of violation of the agreement, however important, will not be permitted to stand in the way of a discussion of the mechanism of international control, which constitutes the heart of the whole problem.

The Acheson-Lilienthal report points out that as long as the Atomic Development Authority operates successfully, the world will at least live in the security of a definite knowledge that no nation is preparing for a sudden atomic onslaught. If then, a nation denounces or violates the provisions of the agreement, it gives a clear warning that it is bent on atomic aggression. It is unrealistic to believe that if such a violation ever occurs, the reactions of the other nations will be limited by the sanction provisions agreed upon when the convention was set up. If the violator be a minor nation, sanctions will be certain and swift. If the agreement be violated by a major nation, the other great nations will hardly be deterred from action by the veto power of the violator. The question will then be one of war or peace and it will make little difference whether the threatening war is "legal" or "illegal" under the veto provisions.

* * *

From this point of view the appraisal of the Russian proposals must be based first of all on its attitude towards the establishment of an effective International Atomic Energy Authority, with assured rights of research, production, control and inspection. In this respect, all that can be said of the Russian declaration is that it is not entirely negative. The only detailed suggestions in the Russian plan deal with outlawing of atomic weapons and with the exchange of information. That the Russians would suggest as a first step the outlawing of atomic weapons, and the destruction of existing bombs, could easily have been predicted; that they would also press for rapid release of all atomic

(Continued on last page)

IN THIS ISSUE

Report on U.N. Atomic Energy Commission

Proceedings of the first meeting of the UN Atomic Energy Commission on June 13, 1946.

* * *

OPENING SPEECH BY T. LIE, Secretary General of UN.

Gentlemen, In opening this meeting of the Commission to deal with the problems raised by the discovery of atomic energy and other related matters, I am deeply aware of the importance of the occasion. The discovery of atomic energy not only marks a great step forward in scientific knowledge, but by the immensity of its implications, it presents a problem which will require all human ingenuity and wisdom for its satisfactory solution. There is scarcely one thinking man or woman in the world today who does not realize that for good or evil mankind has taken a step which may change the political, economic and social structure of our society. All seem agreed that only effective international control can safeguard the right use of atomic energy and ensure that it will be applied for the good of mankind rather than for its destruction.

When the United Nations met in San Francisco to draw up the Charter of the United Nations, atomic energy as a deadly weapon was as yet unknown to the world. At the conference of the Foreign Ministers of the United Kingdom, United States of America and the Union of Soviet Socialist Republics in Moscow, on December 27th, 1945, the three Powers decided to propose, together with China, France, and Canada, to the General Assembly a resolution for the establishment of a Commission to deal with the problems raised by the discovery of atomic energy and other related matters. The General Assembly unanimously adopted this resolution without change on January 24th of this year. The very fact that this was the first resolution adopted by the first session of the General Assembly indicates the importance which the United Nations attaches to international control of atomic energy. The text of the resolution is before you and I shall not take up your time in quoting from it. I will only recall that the United Nations and the whole civilized world expects you to proceed with the utmost speed to inquire into all phases of the problem. You must make recommendations which will ensure the peaceful use of atomic energy and the final elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction. The Atomic Energy Commission is one of the organs of the United Nations. As such, it will draw its strength from the principles which guide this organization. In particular, the Commission is charged with responsibility to serve the Security Council in its task for maintaining international peace and security.

The Commission, which will submit its reports and recommendations to the Security Council and which will be accountable for its work to that body does occupy a position of immense importance in the entire United Nations structure. To a considerable extent the entire course of world peace will depend upon the success of this Commission. The problem of atomic energy is truly one without precedent. For the first time in history a power has been put in our hands which at one single stroke might destroy more than many generations can build. There are those who despair of the future and doubt if man can devise a system to control this new power. I do not agree. It cannot be beyond the resources of the human mind, which has made such enormous strides in its technical development, to control it, to prevent its abuse, and to use it for the good of all. The scientists who have worked on this discovery have been the first to point out its fear of economic implications and to ask for international control. The statesmen of the peace-loving nations express with one voice their desire to harness this fateful energy. People all over the world demand that atomic energy shall be made to lighten the drudgery of their working days rather than fill their lives with fear.

With this support, and despite the greatness of its task, the Commission has every reason to look forward to success. Your problems are in many ways the key to many other problems. Agreement on the major questions of international control of atomic energy should make it possible to approach many other problems with greater ease and confidence. The great significance of atomic energy calls for international statesmanship of the highest order. I feel sure that, given good faith, good will and determination to cooperate, we shall overcome all possible difficulties which may arise in dealing with this epoch-making weapon. Allow me to wish you all a cordial welcome and full success.

BARUCH MADE TEMPORARY CHAIRMAN

MR. LIE: Honorable Delegates, there are many advantages in the fact that the Atomic Energy Commission is holding its first meeting in the United States. This country together with Great Britain and Canada has contributed greatly to the knowledge which we have of the atom and the means of employing its energy. As we are meeting on the soil of the United States, members of the delegations on the Atomic Commission have agre[e] that it would be fitting to ask its di[s]tinguished representative, Mr. Berna[rd] Baruch, to take the chair for the ti[me] being. I take great pleasure in aski[ng] you to accept this honor. I know th[at] you, Mr. Baruch, will assume this du[ty] with a sense of responsibility, wisdom a[nd] foresight. Again I would like to wish y[ou] and all other members of the commissi[on] all the success.

MR. BARUCH: Thanks for the electio[n]; the tribute is to my country and not [to] me. I think I should like to read a war[m] message from the President of the Unit[ed] States:

"White House
Washington, D.C.

Bernard M. Baruch.

I ask you as the American Represent[a]tive on the United Nations Atomic Ener[gy] Commission to express to the membe[rs] my sense of extraordinary importance [of] the work in which they are about to e[n]gage. Nothing concerns the whole wor[ld] more than the achievement of the purpo[se] that brings them together. I speak f[or] my fellow Americans in wishing the[m] God speed.

HARRY S. TRUMA[N]

* * *

At this point Mr. Baruch delivered t[he] major address of the session in which [he] presented the US plan for internatio[nal] control. This address is reprinted in f[ull] on the following pages.

* * *

Proceedings of the second meeti[ng] of the United Nations Atomic Ene[r]gy Commission on June 19, 1946.

The Commission was called to or[der] by its chairman, Dr. Evatt (Australi[a]). The discussion of the report of the ru[les] of procedure committee was postpo[ned] to the next meeting at the suggestion [of] Mr. Gromyko (USSR), and the Comm[is]sion proceeded at once with the gene[ral] debate on the statement of the Uni[ted] States representative Mr. Baruch ma[de] at the first meeting on June 14.

THE CHAIRMAN (DR. EVATT)[:]

I would just like to make one or t[wo] very short observations. First, the re[so]lution of the General Assembly, wh[ich] established this Commission, requires [us] now to deal with the problems raised [by] the discovery of atomic energy and ot[her] related matters and instructs us to p[ro]ceed with the utmost dispatch. Acco[rd]ingly, we have been commanded to ca[rry] out our work in that spirit and to dir[ect] our deliberations towards the ends stat[ed], giving time and attention necessary [to] hear and to study all constructive p[ro]posals and all criticisms which are time[ly].

(Continued on Page 6)

The American Proposal for International Control

. . . presented by *Bernard M. Baruch*

My fellow members of the United Nations Atomic Energy ommission, and my fellow citizens of the world. We are here make a choice between the quick and the dead. That is our isiness.

Behind the black portent of the new atomic age lies a hope hich, seized upon with faith, can work our salvation. If we il, then we have damned every man to be the slave of Fear. et us not deceive ourselves: We must elect World Peace or Vorld Destruction.

Science has torn from nature a secret so vast in its potential- ies that our minds cower from the terror it creates. Yet terror not enough to inhibit the use of the atomic bomb. The terror eated by weapons has never stopped man from employing em, for each new weapon a defense has been produced, in time. ut now we face the condition in which adequate defense does t exist.

Science, which gave us this dread power, shows that it *can* made a giant help to humanity, but science does *not* show how to prevent its baleful use. So we have been appointed obviate that peril by finding a meeting of the minds and the arts of our peoples. Only in the will of mankind lies the swer.

It is to express this will and make it effective that we ve been assembled. We must provide the mechanism to assure at atomic energy is used for peaceful purposes and preclude use in war. To that end, we must provide immediate, swift d sure punishment of those who violate the agreements that e reached by the nations. Penalization is essential if peace is be more than a feverish interlude between wars. And, too, e United Nations can prescribe individual responsibility and nishment on the principles applied at Nuremberg by the nion of Soviet Socialist Republics, the United Kingdom, France d the United States—a formula certain to benefit the world's ture.

In this crisis, we represent not only our governments but, a larger way, we represent the peoples of the world. We ust remember that the peoples do not belong to the governments t that the governments belong to the peoples. We must swer their demands; we must answer the world's longing for ace and security.

In that desire, the United States shares ardently and hope- ly. The search of science for the absolute weapon has ached fruition in this country. But she stands ready to oscribe and destroy this instrument—to lift its use from ath to life—if the world will join in a pact to that end.

In our success lies the promise of a new life, freed from e heart-stopping fears that now beset the world. The beginning victory for the great ideals for which millions have bled d died, lies in building a workable plan. Now we approach fillment of the aspirations of mankind. At the end of the d lies the fairer, better, surer life we crave and mean to ve.

Only by a lasting peace are liberties and democracies engthened and deepened. War is their enemy. And it will not to believe that any of us can escape war's devastation. Victor, nquished and neutrals alike are affected physically, economic- y and morally.

Against the degradation of war we can erect a safeguard. at is the guerdon for which we reach. Within the scope of formula we outline here, there will be found, to those who seek it, the essential elements of our purpose. Others will see only emptiness. Each of us carries his own mirror in which is reflected hope—or determined desperation—courage or coward- ice.

There is a famine throughout the world today. It starves men's bodies. But there is a greater famine—the hunger of men's spirit. That starvation can be cured by the conquest of fear, and the substitution of hope, from which springs faith— faith in each other; faith that we want to work together toward salvation; and determination that those who threaten the peace and safety shall be punished.

The peoples of these democracies gathered here have a par- ticular concern with our answer, for their peoples hate war. They will have a heavy exaction to make of those who fail to provide an escape. They are not afraid of an internationalism that protects; they are unwilling to be fobbed off by mouthings about narrow sovereignty, which is today's phrase for yester- day's isolation.

The basis of a sound foreign policy, in this new age, for all the nations here gathered, is that: anything that happens, no matter where or how, which menaces the peace of the world, or the economic stability, concerns each and all of us.

That roughly, may be said to be the central theme of the United Nations. It is with that thought we begin consideration of the most important subject that can engage mankind—life itself.

Let there be no quibbling about the duty and the responsi- bility of this group and of the governments we represent. I was moved, in the afternoon of my life—shall I say in the late afternoon of my life—to add my effort to gain the world's quest by the broad mandate under which we were created. The reso- lution of the General Assembly, last January 24, 1946, in London, reads:

> **Section V, Terms of Reference of the Commission**
>
> "The Commission shall proceed with the utmost dispatch and inquire into all phases of the problem, and make such recommendations from time to time with respect to them as it finds possible. In particular the Commission shall make specific proposals:
>
> "A. For extending between all nations the exchange of basic scientific inofrmation for peaceful ends;
>
> "B. For control of atomic energy to the extent necessary to insure its use only for peaceful purposes;
>
> "C. For the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction;
>
> "D. For effective safeguards by way of inspection and other means to protect complying States against the hazards of violation and evasions.
>
> "The work of the Commission shall proceed by separate stages, the successful completion of each of which will develop the necessary confidence of the world before the next stage is undertaken."

Our mandate rests, in text and in spirit, upon the outcome of the Conference in Moscow of Messrs. Molotov of the Union of Soviet Socialist Republics, Bevin of the United Kingdom, and Byrnes of the United States of America. The three foreign ministers, on December 27, 1945, proposed the establishment of this body.

Their action was animated by a preceding conference in Washington on November 15, 1945, when the President of the United States, associated with Mr. Attlee, Prime Minister of the United Kingdom and Mr. MacKenzie King, Prime Minister of Canada, stated that international control of the whole field of atomic energy was immediately essential. They proposed the

formation of this body. In examining that source, the Agreed Declaration, it will be found that the fathers of the concept recognized the final means of world salvation—the abolition of war. Solemnly they wrote:

"We are aware that the only complete protection for the civilized world from the destructive use of scientific knowledge lies in the prevention of war. No system of safeguards that can be devised will of itself provide an effective guarantee against production of atomic weapons by a nation bent on aggression. Nor can we ignore the possibility of the development of other weapons, or of new methods of warfare, which may constitute as great a threat to civilization as the military use of atomic energy."

Through the historical approach I have outlined, we find ourselves here to test if man can produce, through his will and faith, the miracle of peace, just as he has, through science and skill, the miracle of the atom.

The United States proposes the creation of an International Atomic Development Authority, to which should be entrusted all phases of the development and use of atomic energy, starting with the raw material and including:

1. Managerial control or ownership of all atomic energy activities potentially dangerous to world security.

2. Power to control, inspect, and license all other atomic activities.

3. The duty of fostering the beneficial uses of atomic energy.

4. Research and development responsibilities of an affirmative character intended to put the Authority in the forefront of atomic knowledge and thus to enable it to comprehend, and therefore to detect, misuse of atomic energy. To be effective, the Authority must itself be the world's leader in the field of atomic knowledge and development and thus supplement its legal authority with the great power inherent in possession of leadership in knowledge.

I offer this as a basis for beginning our discussion.

But I think, the peoples we serve would not believe—and without faith nothing counts—that a treaty, merely outlawing possession or use of the atomic bomb constitutes effective fulfillment of the instructions to this Commission. Previous failures have been recorded in trying the method of simple renunciation, unsupported by effective guarantees of security and armament limitation. No one would have faith in that approach alone.

Now, if ever, is the time to act for the common good. Public opinion supports the world movement toward security. If I read the sign aright, the peoples want a program not composed merely of pious thoughts but of enforceable sanctions—an international law with teeth in it.

We of this nation, desirous of helping to bring peace to the world and realizing the heavy obligations upon us, arising from our possession of the means of producing the bomb and from the fact that it is a part of our armament, are prepared to make our full contribution toward effective control of atomic energy.

When an adequate system for control of atomic energy, including the renunciation of the bomb as a weapon, has been agreed upon and put into effective operation and condign punishments set up for violations of the rules of control which are to be stigmatized as international crimes, we proposed that:

1. Manufacture of atomic bombs shall stop;

2. Existing bombs shall be disposed of pursuant to the terms of the treaty, and

3. the authority shall be in possession of full information as to the know-how for the production of atomic knowledge.

Let me repeat, so as to avoid misunderstanding: my country is ready to make its full contribution toward the end we seek, subject, of course, to our constitutional processes, and to an adequate system of control becoming fully effective, as we fina ly work it out.

Now as to violations: in the agreements, **penalties of as s rious a nature as the nations may wish and as immediate a certain in their execution as possible, should be fixed for:**

1. Illegal possession or use of an atomic bomb;

2. Illegal possession, or separation, of atomic material sui able for use in an atomic bomb;

3. Seizure of any plant or other property belonging to or l censed by the authority;

4. Wilful interference with the activities of the Authority;

5. Creation or operation of dangerous projects in a mann contrary to, or in the absence of, a license granted by the inte national control body.

It would be a deception, to which I am unwilling to lend m self, were I not to say to you and to our peoples, that the matt of punishment lies at the very heart of our present securi system. It might as well be admitted, here and now, that t subject goes straight to the veto power contained in the Chart of the United Nations so far as it relates to the field of atom energy. The Charter permits penalization only by concurren of each of the five great powers—the Soviet Union, the Unit Kingdom, China, France and the United States.

I want to make very plain that I am concerned here wi the veto power only as it affects this particular problem. **The must be no veto to protect those who violate their solemn agre ments not to develop or use atomic energy for destructive pu poses.**

The bomb does not wait upon debate. To delay may be die. The time between violation and preventive action or pu ishment would be all too short for extended discussion as to t course to be followed.

As matters now stand several years may be necessary f another country to produce a bomb, de novo. However, on the basic information is generally known, and the Authori has established producing plants for peaceful purposes in t several countries, an illegal seizure of such plant might perm a malevolent nation to produce a bomb in twelve months, a if preceded by secret preparation and necessary facilities p haps even in a much shorter time. The time required—the a vance warning given of the possible use of a bomb—can o be generally estimated but obviously will depend upon ma factors, including the success with which the Authority h been able to introduce elements of safety in the design of plants and the degree to which illegal and secret preparation f the military use of atomic energy will have been eliminat Presumably no nation would think of starting a war with o one bomb.

This shows how imperative speed is in detecting and pen izing violations.

The process of prevention and penalization—a problem profound statecraft—is, as I read it, implicit in the Mosc statement, signed by the Union of Soviet Socialist Republi the United States and the United Kingdom a few months ago.

But before a country is ready to relinquish any winni weapons, it must have more than words to reassure it. It m have a guarantee of safety, not only against the offenders in t atomic area, but against the illegal users of other weapons bacteriological, biological, gas—perhaps—and why not? agai war itself.

In the elimination of war lies our solution, for only t will nations cease to compete with one another in the producti and use of dread "secret" weapons which are evaluated sol by their capacity to kill. This devilish program takes us ba not merely to the Dark Ages, but from cosmos to chaos. we succeed in finding a suitable way to control atomic weapo it is reasonable to hope that we may also preclude the use

her weapons adaptable to mass destruction. When a man arns to say "A" he can, if he chooses, learn the rest of the phabet, too.

Let this be anchored in our minds:

Peace is never long preserved by weight of metal or by an mament race. Peace can be made tranquil and secure only understanding and agreement fortified by sanctions. We must nbrace international cooperation or international disintegraon.

Science has taught us how to put the atom to work. But to ake it work for good instead of for evil lies in the domain dealing with the principles of human duty. We are now cing a problem more of ethics than of physics.

The solution will require apparent sacrifice in pride and in osition, but better pain as the price of peace than death as e price of war.

I now submit the following measures as representing the ndamental features of a plan which would give effect to rtain of the conclusions which I have epitomized.

1. General—The Authority should set up a thorough plan for ntrol of the field of atomic energy, through various forms of vnership, dominion, licences, operation, inspection, research d management by competent personnel. After this is proded for, there should be as little interference as may be with e economic plans and the present private, corporate and state lationships in the several countries involved.

2. Raw Materials—The Authority should have as one of its rliest purposes to obtain and maintain complete and accurate formation on world supplies of uranium and thorium and to ing them under its dominion. The precise pattern of control deposits of such material will have to depend upon the geogical, mining, refining, and economic facts involved in differt situations.

The Authority should conduct continuous surveys so that will have the most complete knowledge of the world geology uranium and thorium. Only after all current information on orld sources of uranium and thorium is known to us all can uitable plans be made for their production, refining and disibution.

3. Primary Production Plants—The Authority should exerse complete managerial control of the production of fissionable aterials. This means that it should control and operate all ants producing fissionable materials in dangerous quantities d must own and control the product of these plants.

4. Atomic Explosives—The Authority should be given sole d exclusive right to conduct research in the field of atomic plosives. Research activities in the field of atomic explosives e essential in order that the Authority may keep in the foreont of knowledge in the field of atomic energy and fulfill the jective of preventing illicit manufacture of bombs. Only by aintaining its position as the best informed agency will the uthority be able to determine the line between intrinsically ngerous and non-dangerous activities.

5. Strategic Distribution of Activities and Materials — The tivities entrusted exclusively to the Authority because they are trinsically dangerous to security should be distributed throught the world. Similarly, stockpiles of raw materials and fisonable materials should not be centralized.

6. Non-Dangerous Activities—A function of the Authority ould be promotion of the peacetime benefits of atomic energy.

Atomic research (except in explosives), the use of research actors, the production of radioactive tracers by means of nonngerous reactors, the use of such tracers, and to some extent e production of power should be open to nations and their tizens under reasonable licensing arrangements from the uthority. Denatured materials, whose use we know always also requires suitable safeguards, should be furnished for such purposes by the Authority under lease or other arrangement. Denaturing seems to have been over-estimated by the public as a safety measure.

7. Definition of Dangerous and Non-Dangerous Activities—Although a reasonable dividing line can be drawn between dangerous and non-dangerous activities, it is not hard and fast. Provision should, therefore, be made to assure constant reexamination of the questions, and to permit revision of the dividing line as changing conditions and new discoveries may require.

8. Operations of Dangerous Activities—Any plant dealing with uranium or thorium after it once reaches the potential of dangerous use must be not only subject to the most rigorous and competent inspection by the Authority, but its actual operation shall be under the management, supervision and control of the Authority.

9. Inspection—By assigning intrinsically dangerous activities exclusively to the Authority, the difficulties of inspection are reduced. If the Authority is the only agency which may lawfully conduct dangerous activities, then visible operation by others than the Authority will constitute an ambiguous danger signal. Inspection will also occur in connection with the licensing functions of the Authority.

10. Freedom of Access—Adequate ingress and egress for all qualified representatives of the Authority must be assured. Many of the inspection activities of the Authority should grow out of, and be incidental to, its other functions. **Important measures of inspection will be associated with the tight control of raw materials, for this is a keystone of the plan.** The continuing activities of prospecting, survey and research in relation to raw materials will be designed not only to serve affirmative development functions of the Authority, but also to assure that no surreptitious operations are conducted in the raw materials field by nations of their citizens.

11. Personnel—The personnel of the Authority should be recruited on a basis of proven competence but also so far as possible on an international basis.

12. Progress by Stages—A primary step in the creation of the system of control is the setting forth, in comprehensive terms of the functions, responsibilities, powers and limitations of the Authority. Once a Charter for the Authority has been adopted, the Authority and the system of control for which it will be responsible will require time to become fully organized and effective. The plan of control will, therefore, have to come into effect in successive stages. These should be specifically fixed in the Charter or means should be otherwise set forth in the Charter for transitions from one stage to another, as contemplated in the resolution of the United Nations Assembly which created this Commission.

13. Disclosures—In the deliberations of the United Nations Commission on Atomic Energy, the United States is prepared to make available the information essential to a reasonable understanding of the proposals which it advocates. Further disclosures must be dependent, in the interests of all, upon the effective ratification of the treaty. When the Authority is actually created, the United States will join the other nations in making available the further information essential to that organization for the performance of its functions. **As the successive stages of international control are reached, the United States will be prepared to yield, to the extent required by each stage, national control of activities in this field to the Authority.**

14. International Control—There will be questions about the extent of control to be allowed to national bodies, when the

(Continued on Page 10)

(Continued from Page 2)

Already the United States Representative on the Commission, Mr. Baruch, has given the Commission a splendid lead. In his speech he placed before us the outline of the plan for a world authority to deal with atomic energy. The broad features of this plan will appeal to many of us as the proper basis on which to build our proposals. Others might wish to suggest modifications or even to put forward another plan, and this general discussion will be the starting point in our deliberations. So today, and on the next day of our sitting, I hope that the Members of the Commission will be able to indicate their reaction to Mr. Baruch's proposals and indicate the general nature of any alternative plan or proposal which they may wish to bring before the Commission.

After the general discussion is completed—and each Member of the Commission is of course invited to take part in it—I will endeavor to sum up for the benefit of the Commission the area of agreement which is revealed by the general discussion and then I shall put before my colleagues on the Commission practical proposals so as to set about working on a preliminary draft of a Charter which we can then consider in detail.

GENERAL McNAUGHTON: (CANADA)

Mr. Chairman, at the first meeting of the Commission on Friday last, we had the privilege of listening to the constructive and imaginative proposals which were put before us by Mr. Baruch on behalf of the Government of the United States.

I am now authorized to say that the Canadian Government welcomes this approach to the problems before the Commission and that Canada supports the principles on which those proposals have been based. We are well aware that proposals so novel and far-reaching will encounter many difficulties. Some of these, no doubt, will be hard to overcome, but we should not be deterred; for on the success of our efforts the future of the world depends.

The plan which Mr. Baruch has suggested will need the most careful study. If accepted as a basis of discussion in this Commission, as I hope it will, we shall have to examine fully its implications with a view to drawing up concrete and detailed recommendations.

The question of enforcement action arising out of these recommendations may, of course, involve the veto. The Canadian attitude toward the veto power of the five permanent members in the Security Council is that we have never liked it. We accepted it at San Francisco because it seemed the only basis on which the great powers could come together to set up the United Nations Organization.

I suggest, however, that at this stage we should not concern ourselves unduly over the procedure whereby the present decisions of the proposed International Atomic Development Authority should be taken. Rather, I suggest that we should concentrate on the many other aspects of the proposals put forward by the United States Representative on which we must reach agreement before the Authority can be brought into being. If we succeed in achieving a meeting of minds on these aspects, we may find that we have established a degree of confidence which will make it much easier than at present to solve this difficult problem. The question of establishing mutual confidence is certainly a vital aspect of our work at this time.

The Canadian Delegation believes that this can be best promoted by developing specific proposals on the first matter listed in our terms of reference, namely. "for extending between all nations the exchange of basic scientific information for peaceful purposes."

We are deeply conscious in Canada of the responsibilities which have fallen to us in connection with the development of atomic energy. In the national sphere, the Candian Government has introduced legislation to control the production of atomic energy and the materials from which this energy is derived; and to stimulate research and development so that it may be directed toward constructive ends. A bill for this purpose is before the House of Commons in Ottawa, and the debate which has taken place has shown that its principles have been given the widest public support.

This legislation will enable Canada not only to control and promote the development of atomic energy for peaceful purposes in our country, but also to insure that our program may be brought fully into accord with the policies of any world Authority that may be agreed upon.

Our precious supplies of raw materials have already been brought under the full control of the Government so that they may be conserved. An experimental uranium fission plant has been erected. This plant, whose capacity is in no way significant for war purposes, is being developed as a research center and as a source of radioactive products which can be distributed to suitable laboratories and to hospitals for use in medical treatments.

Once appropriate arrangements have been concerted with other nations, we hope to see scientists from all over the world as our guests, and to have our own scientists received in other countries for periods in exchange.

Mr. Chairman, you may be sure that w[e] will bend every effort to advance the hig[h] purposes for which this Commission ha[s] been established.

SIR ALEXANDER CADOGAN (UNITE[D] KINGDOM):

Mr. Chairman, I am sure that no on[e] who was privileged to listen to the state[-]ment made by the Delegate of the Unite[d] States on June 14 can have failed to b[e] impressed with the importance of the oc[-]casion or to be moved by the very obviou[s] sincerity of Mr. Baruch's sentiments. Th[e] outline which he then gave of his schem[e] must have inspired hope in all who are me[t] here together to devise a plan for peacefu[l] development and for defense against th[e] danger that may threaten the world.

His Majesty's Government in the Unite[d] Kingdom warmly welcome the statemen[t] by the United States Representative an[d] are grateful to the United States Govern[-]ment for providing so broad and constru[c-]tive a basis for the Commission's wor[k]. Mr. Baruch's proposals would give effe[ct] to the terms of reference of the Commis[-]sion and would do more by weaving th[e] various specific tasks laid upon the Com[-]mission into a complete plan. His Majesty['s] Government in the United Kingdom greatl[y] hope that it will be possible to create [a] structure on these foundations and pledg[e] to this work the fullest possible contribu[-]tion of the United Kingdom Delegation o[n] the Commission.

A particular point in the United Stat[es] scheme which specially struck the Unite[d] Kingdom Government is that the Inte[r-]national Development Authority would a[c-]custom the different nations to working i[n-]ternationally in the atomic field, both fo[r] industrial purposes and other specific pu[r-]poses. Thus its staff will become accu[s-]tomed to genuine cooperation, instead o[f] being confined to the role of police inspec[t-]ors. This should help to surmount what ha[s] always been forseen as a serious practic[al] difficulty since the work will be such as t[o] attract the keenest scientific minds o[f] every nation. At the same time it will a[l-]most certainly prove impossible to di[s-]pense with some scheme of inspection an[d] control at least of all "dangerous" activ[i-]ties in the field of atomic energy.

The United States plan makes grea[t] demands for confidence and cooperatio[n] from all parties. We must recognize tha[t] full confidence and cooperation cannot b[e] built up in a day. Consequently, as th[e] terms of reference of the Commissio[n] specifically contemplated, the work o[f] building up international control mu[st] proceed by stages. His Majesty's Gover[n-]ment in the United Kingdom endorse th[e] emphasis laid upon this policy in the state[-]ment by the United States Delegate.

They would suggest that in order to romote an atmosphere of goodwill and f confidence in the ultimate success of the roposals it might be well to proceed as on as may be appropriate with the exange of scientific information. This ould be in accord with the general policy f the Washington Declaration and with e terms of reference of the Commission.

Obviously, this great plan involves risks. e United Kingdom is perhaps particurly conscious of these risks since it sufred so severely from air bombardment in e late war and was the subject of a susined attempt by the enemy to disrupt s industrial production and the morale its citizens by unrestricted attack by rcraft and by every fearful new invention hich the enemy were able to devise in the ort time available to them.

Consequently, His Majesty's Governent fully endorse the emphasis laid in e United States statement on the need r condign, immediate and effective penties against violation of the future intertional scheme of control. The greatest eterrent value against any such violation ill be the knowledge that punishment will inevitable and overwhelming. Clearly, e scheme outlined by the United States presentative raises most important and r reaching questions of political and ilitary procedure as well as problems a technical and scientific nature. For ample, there is the question of the actual eapons with which penalties would be forced on a transgressor and this is one the crucial points in the scheme which ll require particular study. Peace has en defined as depending always on there ing overwhelming power behind just w.

Account would naturally be taken at the me time of any proposals that might be ade by other delegations. For their part, wever, His Majesty's Government in the nited Kingdom, are glad to take the nited States scheme as the basis for conleration since in many of its essentials is in accord with the lines on which they d themselves been approaching the probn. They do not wish therefore, to put rward an alternative scheme, but will ply their own ideas in the discussion of e United States scheme.

His Majesty's Government in the United ngdom, like the other Governments hich are represented on the Commission ll, of course, require time to study the ry important proposals. The Commission breaking entirely new ground and while must never lose sight of the urgency of e problem, it must also proceed carefully d with due consideration of all the many ints raised. If this preliminary discussion which the Commission has embarked veals that the Governments here reprented are agreed on the general line to followed, it is to be hoped that it may oceed to discuss and determine the method of its work. It must make an early beginning: it must settle where to begin, and then put all its strength and determination into an effort to bring the work to an acceptable and beneficent end.

Mr. President, if I may add one word for myself, I would observe that in past years, it has happened that I have been associated in some way with discussions on the regulation of armaments, control and inspection, and kindred topics. During those years, I have often heard it objected that this scheme or that is impossible. During those same years, it was "impossible" to release the giant atomic forces. Our scientists have now achieved that, so now we too must take part and achieve the "impossible".

* * *

At this point, Mr. Gromyko delivered the major address of this session in which he presented the USSR view on international control. This is reproduced in full on the following pages.

* * *

DR. QUO (CHINA):

I wish to express, on behalf of my government, our keen appreciation of the great contribution that Mr. Baruch has already made at this initial stage of our labors. This is indeed a source of inspiration and encouragement to us all and to an anxious world.

In welcoming the United States Government's proposal as a basis for our deliberations, I wish to confine myself today to making two observations of a general character on behalf of my government.

My first observation concerns the composition of the proposed International Development Authority. The United States proposal does not seem to provide for the composition of that body. Since that body is to be a vital instrument of the United Nations under the Security Council, it is highly important that this new body should be based on broad and democratic participation so as to include, like the Security Council, a substantial representation of small nations. This is not only in consonance with the spirit of the Charter but will create a wider sense of security throughout the world.

My second observation deals with the question of veto as applied to the field of atomic energy. My government is in full accord with the United States proposal that "there must be no veto to protect those who violated their solemn agreements not to develop or use atomic energy for destructive purposes."

CAPTAIN AVARO ALBERTO (BRAZIL):

The representative of Brazil has the honor to affirm the full approval of the Brazilian Delegation of the principles stated in the American plan for the international supervision of atomic energy.

As a whole, the American plan seems to us to sum up three important aspects of the question. In the first place, a new formation, a new configuration of international law through the establishment of an international authority responsible for the complete control of the sources and application of atomic energy in view of the necessity imposed by the conditions of war-time to prevent the use of this energy as a military instrument. Secondly, measures relating to the complete international control of means already existing as regards armaments and the production of atomic energy. Next, the legal definition of the new norms of penal law which flow from the international agreement proposed and the consequent imposition of penalties. All these propositions imply, of course, restrictions upon the sovereignty of states. Although applying collectively to all the states that accept it, it will thus be particularly applicable towards those who possess means of production of atomic energy. But this sacrifice made for the sake of the impositions from above of the common good will be compensated, for it can only add to the dignity of the patrimony of the nations which accept it.

DR. VALLARTA (MEXICO):

Mr. Chairman, in the name of the Mexican Delegation I wish to state first that explicit instructions have been received from my Government to approve the elimination of the veto power as far as the questions coming under the jurisdiction of the Atomic Energy Commission are concerned, as proposed by the Representative of the United States.

Further, I wish to mention that, in general, the proposals stated by Mr. Baruch in his speech of June 14th are acceptable to Mexico, although the question of managerial control of deposits of uranium ores would still require separate and careful consideration.

CHAIRMAN: As I stated, that concludes the list of speakers on this subject for this afternoon. At the next meeting we shall conclude this general discussion. Some Members have expressed their desire to consider what has been said this afternoon and make observations at the commencement of the next meeting. After that is done, I propose to bring up the question of procedure which was postponed until the next meeting, and then I propose to do what I indicated earlier, to put before the Commission working plans to see what area of agreement between us can be reached, and also to consider plans for the establishment of necessary committees to carry out the principles upon which we can agree. I think it is essential to do that so that the next meeting should conclude by saying the Commission is ready to get down to detailed work.

The Russian Proposal for International Control

. . . presented by *Andrej Gromyk*

Mr. President, the Commission for the Control of Atomic Energy, created in accordance with the decision of the Moscow Conference of the Foreign Ministers of the Three Powers and with the decision of the first session of the General Assembly, must proceed to the practical realization of the task set before it. The significance of these tasks and consequently, of the activities of the Commission, are determined by the significance of the very discovery, and is doubtless only a foretaste of still greater conquests of science in this field in the future, and it emphasizes the great importance of the tasks of this Commission and therefore of the activities of this Commission. As a result of developments in the last few years, circumstances have brought it about that one of the most important discoveries of humanity has found its application at the outset in a particular form of weapon, the atomic bomb. However, although, up to the present time, this use of atomic energy is the only known form for its practical application, it is the general opinion that humanity stands at the threshold of a wide application of atomic energy for peaceful purposes; for the good of the peoples as a means of raising their standards of welfare and their living conditions; for the good of and with a view to the development of science and culture.

There are thus two possible ways in which atomic discoveries can be used. One way is the use of these discoveries for the purposes of producing means of mass destruction. The other way is the use of this discovery for the welfare of humanity.

The paradox of the situation lies in the fact that it is the first way that has been studied most and most applied in practice. The second way has been studied and practically applied less. However, this circumstance does not diminish the importance of the tasks which lie ahead of the Atomic Commission, but, on the contrary, emphasizes still further in a high degree the meaning of these tasks from the point of view of the reinforcement of peace between the peoples. There can be no active and effective system of peace if the discovery relating to the ways of using atomic energy is not placed in the service of humanity and is not applied to peaceful purposes only. The use of such a discovery only for the purposes of raising the welfare of the peoples and widening of their scientific and cultural horizons will help to strengthen confidence between the countries and friendly relations between them.

On the other hand, if we continue to use these discoveries for the production of weapons of mass destruction we may intensify mistrust between states and keep the peoples of the world in continual anxiety and mistrust. Such a position would work against the aspirations of the peace-loving peoples who are thirsting for the establishment of a solid peace and who are making every effort to insure that their aspirations shall be transformed into reality.

As one of the first measures to be carried out, in order to carry out the decision of the General Assembly of the 24th of January, the Soviet Delegation proposes a study of the question of the conclusion of international agreements forbidding the production and use of weapons based upon the use of atomic energy for the purposes of mass destruction. The purpose of such an agreement should be to forbid the production and use of atomic weapons, the destruction of existing stocks of atomic weapons, and the punishment of all activities undertaken with a view to the violation of such agreements. The elaboration and conclusion of such agreements would be, in the opinion of the Soviet Delegation, only one of the primordial measur which must be taken to prevent the use of atomic energy harm humanity. It should be followed by other measures d signed to introduce means of assuring a strict supervision the observance of undertakings entered into, the conclusion connection with the above-mentioned agreements, the setting of a system of supervision and control to see that the conve tions and agreements are observed, and measures concerni sanctions against unlawful use of atomic energy.

The public opinion of the whole of the civilized world h already condemned the use in war of suffocating, poisonous, a other similar gases, and the use of liquids and substances of t same character, as also bacteriological weapons, and have co cluded agreements forbidding the use of such weapons. F this purpose the necessity of concluding agreement forbiddi the production and use of atomic weapons is even more obviou

Such a convention would correspond in a high degree also, the aspirations of the peoples of the whole world. The concl sion and elaboration of such an agreement and such a syste of measures to insure the strict observance of the clauses the agreements, the establishment of a system of control see that the obligations contained in the agreements were o served and the establishment of sanctions against those w violate the agreements, all this, in the opinion of the Sovi Delegation, would constitute an important step in advance the way of carrying out the tasks laid upon the Atomic Ener Commission. It would also fully correspond to the aspiratio and the dictates of common sense of the whole of progressi humanity. The need for its acceptance by states of the oblig tion not to produce or use atomic weapons is dictated by t fact that the character of the atomic weapon is such that application would mean untold misery to the whole of t peaceful population of the countries concerned.

The results of the use of this weapon are incompatible wi the generally accepted rules and the ideas reinforced by t common sense of humanity over a period of many centuri regarding the rules for the conduct of war which lay do that innocent civilian population should not be destroyed. T situation, as it exists at the present time, created by the d covery of the means of applying atomic energy and the u of these means for the production of atomic weapons, exclud the possibility of normal scientific cooperation between t states of the world.

One of the fundamental elements of the existing situati is characterized by the absence of any kind of limit to t production and application of atomic weapons. These eleme are important considerations, and only strengthen the suspici existing between countries and worsen the relations betwe them, calling forth political instability. It is clear that a co tinuation of this situation is likely to bring only negative sults for the peace of the world.

Besides this, the continuation of the existing situation wo mean that the most recent scientific attainments in this fi could not constitute a basis for joint scientific efforts amo the countries, directed towards the discovery and the perfecti of methods of using atomic energy for peaceful purposes. Fr this there follows only one correct conclusion, namely, that is indispensible that **there should be an exchange of scienti information between countries and that it is indispensible th there should be joint scientific efforts directed towards a broad ing of the possibilities of the use of atomic energy only in t interests of the raising of the material welfare of he peo and in the deveopment of science and culture. The success** the work of this Commission will be determined in a lar

easure by the extent to which it solves this important task.

The proposal for a wide exchange of scientific information timely because it arises from the fact that such scientific disveries as the discovery of methods of using atomic energy nnot remain for an indefinite time the property of any one untry or any group of countries; inevitably, it becomes the operty of many countries. This confirms the necessity of a ide exchange of scientific information upon the problem bere us and the necessity of elaborating measures in this field, cluding organizational methods.

I have already stated Mr. Chairman, the general position regards the task and character and the activities of the comission for the control of atomic energy. In the development this general position, I would wish, upon the recommendaon of my government, to lay before the commission two con**ete proposals which in the opinion of the Soviet Government ay constitute a basis for the adoption by the commission of recommendation to the Security Council** and thus play an imrtant role in the task of strengthening the peace.

The proposals are as follows. The first one concerns the nclusion of an international agreement for the outlawing of e production and application of a weapon based upon the use atomic energy for the purposes of mass destruction. The cond concerns an organization of the work of the commission r the control of atomic energy. I will read the text of the st proposal.

Draft International Agreement to forbid the production and e of weapons based upon the use of atomic energy for the rposes of mass destruction. There follows after this a list the signatory states, and the text continues: "Deeply aware the extreme importance of the great scientific discoveries nnected with the splitting of the atom and with a view to e use of atomic energy for the purposes of raising the welfare d standard of life of the peoples of the world, and also for e development of culture and science for the good of human-; unanimously desiring universal cooperation as wide as ssible for the use of all people of scientific discoveries in the ld of atomic energy, for the improvement of the conditions the life of the peoples of the whole world, the raising of their andard of welfare and further progress of human culture; king account clearly of the fact that the great scientific disveries in the field of atomic energy, contain a great danger st and foremost for the peaceful towns and civilian populans in case such a discovery were used as a means of apply- an atomic weapon for the purposes of mass destruction; king note also of the great importance of the fact that rough international agreements, the use in time of war of ffocating, poisonous and other similar gases and also similar uids, substances and processes, and also bacteriological ethods have already been outlawed by common accord between e civilized peoples; and considering that the international tlawry of the use of the atomic weapon for mass destruction uld correspond in still greater measure to the aspirations and e conscience of the peoples of the whole world; animated by intense desire to remove the threat of the use of these scitific discoveries for the harm of humanity and against the erests of humanity; the high contracting parties decided to nclude an agreement to forbid the production and use of a eapon based upon the use of atomic energy, and for this purse, appointed as their plenipotentiaries"—and here the list plenipotentiaries will follow, whose credentials are found to in due form—"agree as follows.

ARTICLE 1: The high contracting parties solemnly declare at they will forbid the production and use of a weapon based on the use of atomic energy, and with this in view, take upon emselves the following obligations:

(a) Not to use, in any circumstances, an atomic weapon;

(b) To forbid the production and keeping of a weapon based on the use of atomic energy;

(c) To destroy within a period of three months from the entry into force of this agreement all stocks of atomic energy weapons whether in a finished or semi-finished condition.

ARTICLE 2: The high contracting parties declare that any violation of Article 1 of this agreement shall constitute a serious crime against humanity.

ARTICLE 3: The high contracting parties, within six months of the entry into force of the present agreement, shall pass legislation providing severe punishment for the violation of the terms of this agreement.

ARTICLE 4: The present agreement shall be of indefinite duration.

ARTICLE 5: The present agreement is open for signature to all States whether or not they are Members of the United Nations.

ARTICLE 6: The present agreement shall come into force after approval by the Security Council, and after ratification by half the signature States, including all States Members of the United Nations, as under Article 23 of the Charter. The ratifications shall be placed for safe keeping in the hands of the Secretary-General of the United Nations.

ARTICLE 7: After the entry into force of the present agreement, it shall be an obligation upon all States whether Members or not of the United Nations.

ARTICLE 8: The present agreement of which the Russian, Chinese, French, English and Spanish texts shall be authentic, is drawn up in one copy and will be in the safe keeping of the Secretary-General of the United Nations. The Secretary-General shall communicate to all signatories a duly certified copy thereof.

I would like now to read the text of the second proposal. It concerns the organization of the work of the Commission for the control of atomic energy. Basing ourselves upon the decision of the General Assembly of the 24th of January, 1946, concerning the setting up of a Commission for the study of problems connected with the discovery of atomic energy and other related questions, and in particular upon Article 5 of this decision, stating the terms of reference of the Commission, the Soviet Delegation considers it necessary to make the following proposals concerning the plan of the organization of the work of the Commission for the initial period of its activity.

1. The setting up of committees of the Commission, pursuing the aims indicated in the decision of the General Assembly to "proceed with the utmost dispatch and inquire into all phases of the problem and make such recommendations from time to time with respect to that as it finds possible."

In connection with this item, it seems quite necessary to establish two committees which as auxiliary organs of the Commission would be responsible for a general study of the problem of atomic energy and the elaboration of recommendations which the Commission might make for the carrying out of the decision of the General Assembly and other organs of the United Nations.

It is proposed that there should be set up two committees, the first a committee for the exchange of scientific information. This committee would be set up for the purpose of studying point (a) of Article 5 of the decision of the General Assembly of the 24th of January, 1946. Among the tasks of this committee would be that of elaborating recommendations concerning practical measures for the organization of the exchange of information, (1) concerning the contents of scientific discoveries connected with the splitting of the atom and other discoveries connected with the obtaining and use of atomic energy, and

(2) concerning the technology and the organization of technological processes for obtaining and using atomic energy. (3) Concerning the organization and method of industrial production of atomic energy and the use of such energy. (4) Concerning forms, sources, and the location of raw materials necessary for obtaining atomic energy.

I come now to the second proposed committee whose task would be to prevent the use of atomic energy for the harm of humanity. This committee should be set up in order to attain the aims set forth in points (b), (c), and (d) of Article 5 of the decision of the General Assembly. **The task of this committee would be to prepare recommendations on the following subjects:**

1. The preparation of a draft international agreement for the outlawing of weapons based upon the use of atomic energy and forbidding the production and use of such weapons and all similar forms of weapons destined for mass destruction.

2. The elaboration and creation of methods to forbid the production of weapons based upon the use of atomic energy and to prevent the use of atomic weapons and all other similar weapons of mass destruction.

3. Measures, systems and organizations, of control in the use of atomic energy to insure the observance of the conditions above-mentioned in the international agreement for the outlawing of atomic weapons.

4. The elaboration of a system of sanctions for application against the unlawful use of atomic energy.

Part 2: The composition of the committees. Each committee would be composed of one representative of each state represented in the Commission. Each representative may have advisors.

3. Rules of procedure of the committees. The rules of procedure of committees shall be drawn up by the Commission.

Like the proposal for the conclusion of the agreement, these proposals which concern the organization of the work of the Commission are a practical means of advancing at the present time. The convention would be a concrete and important step forward in the direction of setting up an effective system of control of atomic energy. This measure would have an immens moral and political significance and might strengthen the p litical stability in the world and the friendly relations betwee the peoples. The creation of the two committees that I hav proposed with the tasks as I define them, would mean the adop tion of a concrete plan of work of the Commission in the initi stages of its activities and would at the same time mean th adoption of the necessary organizational forms for the carryin out of its work which would enable it to proceed quickly in th proposals of the broad exchange of scientific information an on questions related to the prevention of the use of atom energy for the harm of humanity. The activity of the Con mission for the control of atomic energy can lead to the desire result only if it is in full conformity with the principles of th Charter of the United Nations which are at the basis of th activity of the Security Council because the Commission is a organ of this Organization, working under the direction of th Security Council.

Efforts made to undermine the activity of the Securit Council, including efforts directed to undermine the unanimit of the Members of the Security Council, upon questions of sul stance are incompatible with the interests of the United Natior created by the international organization for the preservatio of peace and security. Such attempts should be resisted. I cor sidered it necessary to make this statement in order that fro the very beginning of the work of our Commission I migl make clear the position of the Soviet Government as regarc the question of the character and basis of the work of th Commission upon the question of the preparation of its recon mendations as regards measures of control of atomic energ placed before the Security Council.

In conclusion, I wish to say that in this statement I aime chiefly at underlining the extreme importance to be attribute to the conclusion of the above mentioned agreement for th outlawry of the production and use of atomic weapons. Th conclusion of such an agreement would constitute an importa practical step in the direction of fulfilling the task which li before the Commission.

The American Proposal

. . *Continued from page*

Authority is established. **Purely national authorities for control and development of atomic energy should to the extent necessary for the effective operation of the Authority be subordinate to it.** This is neither an endorsement nor a disapproval of the creation of national authorities. The Commission should evolve a clear demarcation of the scope of duties and responsibilities of such national authorities.

And now I end, I have submitted an outline for present discussion. Our consideration will be broadened by the criticism of the United States proposals and by the plans of the other nations, which, it is to be hoped, will be submitted at their earliest convenience. I and my associates of the United States Delegation will make available to each member of this body books and pamphlets, including the Acheson-Lilienthal report, recently made by the United States Department of State, and the McMahon Committee Monograph No. 1 entitled "Essential Information on Atomic Energy" relating to the McMahon Bill recently passed by the United States Senate, which may prove of value in assessing the situation.

All of us are consecrated to making an end of gloom and hopelessness. It will not be an easy job. The way is long and thorny, but supremely worth traveling. All of us want to stand erect, with our faces to the sun, instead of being forced to bu row into the earth like rats.

The pattern of salvation must be worked out by all for a

The light at the end of the tunnel is dim, but our path seen to grow brighter as we actually begin our journey. We cann yet light the way to the end. However, we hope the suggestio of my government will be illuminating.

Let us keep in mind the exhortation of Abraham Lincol whose words, uttered at a moment of shattering national per form a complete text for our deliberation. I quote, paraphrasi slightly:

"We cannot escape history. We of this meeting will be r membered in spite of ourselves. No personal significance insignificance can spare one or another of us. The fiery tri through which we are passing will light us down in honor dishonor to the latest generation.

"We say we are for Peace. The world will not forget th we say this. We know how to save Peace. The world kno that we do. We, even we here, hold the power and have t responsibility.

"We shall nobly save, or meanly lose, the last, best hope earth. The way is plain, peaceful, generous, just—a way whic if followed, the world will forever applaud."

A Beginning for Sanity

. . . . . Norman Cousins and Thomas K. Finletter

A Review of the Acheson-Lilienthal Report

It is almost a year since this government first learned it could make an atomic weapon. But during that time the making of a policy to deal with it has had nothing of the bristling urgency and determination that went into the making of the bomb. Instead of a bold, affirmative program whose dimensions bore some relationship to the size of the problem, America has exhibited a policy of drift, default, and delay. It is doubtful whether ever in our history there has been an uglier or more ominous frittering away of critically valuable time.

Why is time so valuable? Simply because each day brings us closer to the time when other nations, working entirely on their own and without benefit of our much-vaunted "secrets," will have their own atomic weapons. The moment that happens—and we are advised by competent nuclear physicists not to count on a time factor of more than two or three years—it may be too late to set up world controls under world law. The atomic armaments race now being fertilized will have been born and fully formed.

And an armaments race is an armaments race, whether in respect to atomic weapons, battleships, bullets, or bows-and-arrows. As the stockpiles of weapons mount, so do the provocations and the tensions—curiously though not surprisingly. And the final provocation almost magically coincides with the discovery by any one nation or coalition of nations that it has a decisive margin in armaments over the others.

But the American people today have pennies over their eyes—pennies that blot out the bright light of sanity, pennies that prevent them from recognizing issues that will determine whether any of us will be alive a few years from now. These pennies are the domestic squabbles that have become not only a national preoccupation but a national obsession.

There seems to be no perceptible resistance to the idea of relying upon an atomic armaments race for security, or to the dangers that are inherent in such a race. It may be that the job of world control over atomic weapons and all other weapons of mass destruction is too demanding for a nation that feels it is entitled to a respite after a war. It may be that we are interested only in jobs we can cut down to our own size. It may be that we are so fascinated with limited objectives, and with ingrained ideas of gradualism, that we may not understand the crucial need for a majestic awareness of the immediateness of the problem and a determination to come to grips with the seemingly impossible.

If this drift seems like madness, consider how the madness is multiplied in view of the new implications of atomic warfare. A bigger stockpile of bombs offers little or no security to a nation which is hit first, particularly since the first blow may be the conclusive blow. It may very well be that we have fought the last war in which it will be possible to retaliate after the first blow is struck. For a nation which, by its very nature as well as by its constitutional processes, will not indulge in blitzkrieg aggression, a superior stockpile of atomic bombs may actually represent an added margin of danger rather than of defense in that it increases the chances of that nation being hit first in order to get it out of the way. The only real protection for a democracy in an atomic age is an organized peace under world law—the type of peace that some of our statesmen say we cannot have because the American people are not yet ready to make whatever readjustments of sovereignty are necessary to bring it about.

CONSEQUENCES OF AN ARMAMENTS RACE

This reluctance of course ignores some fairly fundamental readjustments that will have to be made once the atomic race is on in earnest. Do the American people know that an atomic armaments race means more than the manufacture of atomic bombs? Do they know it inevitably means the redistribution of population, the decentralization of our cities, the dispersal of our industries? Do they know that every American will be directly affected, that the required controls will of necessity be in the hands of the military, that it is a real question whether free institutions as we understand them can be maintained under the pressure of such vast and complicated changes? Do they know, finally, that America may be only a very few years away from such a "readjustment" and that the plans are even now being drawn up for that purpose?

This is not a matter of the military deliberately plotting to seize control of the nation. What is happening is that our failure to create a sound policy for atomic energy and other weapons of mass destruction looking toward effective world control creates a vacuum which is automatically being filled by the military. No one would ever accuse General Eisenhower or General Marshall of plotting a military state; but a powerful momentum is being set up which will inevitably force the War Department to carry out the biggest and most complicated physical change-over of a nation in the world's history—with all that that implies in the way of political and social readjustment and control.

If we ask ourselves how it is that we now find ourselves in this difficult and dangerous situation; how it is that only one year after victory the crisis is as serious, perhaps even more serious, considering our present unawareness of the danger, than it was at any time during the war; if we ask ourselves these questions, we naturally look back to see whether we have made any errors which figured in bringing about this danger, and, if so, whether the same policy that was responsible for these errors is still in effect.

There can be little question that the first error may have been the biggest error. The first error was the atomic bombing of Hiroshima. Not the making of the atomic bomb; that we were forced to do out of sheer national preservation, for the enemy was working on atomic weapons as well. It was what we did with the atomic bomb after we made it that was a mountainous blunder.

THE SCIENTISTS SPEAK

In making such a statement, we of course realize that it is highly volatile and requires full support and documentation. In creating a proper perspective for such substantiation, we refer to a report turned in to the War Department on June 11, 1945—one month before the New Mexico test, two months before Hiroshima. The report was made by a Committee on Social and Political Implications consisting of three physicists, three chemists, and one biologist under the chairmanship of Professor James Franck, of the University of Chicago.* This report, not made public by the War Department at the time, is one of the most important American documents of recent years—even though it is virtually unknown to the American people. It is, in effect, a declaration of conscience and responsibility by scientists—a declaration that their first duty was to the general welfare, that they did not propose to stand aside in parched detachment while the products of their research were applied.

"In the past," they wrote, "scientists could disclaim direct responsibility for the

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use to which mankind had put their disinterested discoveries. We now feel compelled to take a more active stand because the success which we have achieved in the development of nuclear power is fraught with infinitely greater dangers than were all the inventions of the past. All of us, familiar with the present state of nucleonics, live with the vision before our eyes of sudden destruction visited on our own country, of a Pearl Harbor disaster repeated a thousand-fold magnification in every one of our major cities."

Soberly, and with great simplicity, they went on to show why no defense could be devised to offer *adequate* protection against a surprise atomic attack, and why only *adequate* international political organization of the world could offer any hope of security. They demonstrated why there were actually no "secrets" that other nations could not develop for themselves based on the actual knowledge of nucleonics known to exist in scientific laboratories throughout the world, and that all we had was a head start of perhaps a few short years.

They explained the peculiar vulnerability of America to atomic attack; why our densely populated metropolitan districts and our concentrated industries could be destroyed by instant and synchronized sabotage, if not by overhead attack. They explained why a quantitative advantage in atomic bombs was only an illusory advantage. "We are in a less favorable position than nations which are either now more diffusely populated and whose industries are more scattered, or whose governments have unlimited power over the movement of population and the location of industrial plants. . . . Russia and China are the only great nations at present which could survive a nuclear attack."

Because of all this, the report said, it was of critical importance that the bomb not be introduced in a way that would jeopardize America's long-range security, however great the apparent short-range advantages. A surprise attack by us with this new weapon—without any advance demonstration and without any ultimatum—involved much more than local military considerations. It required a political decision on the highest level.

Taking all this into account, the report recommended that the new weapon be demonstrated before the world, to be witnessed by representatives of the United Nations. The test bombing would be held on a barren island with appropriate safeguards.

What was happening was that the scientists were looking ahead, bearing in mind that the war with Germany was over and that we were already closing in for the kill in Japan; looking ahead and trying to anticipate the nature of the problem of world control of atomic energy after the war was over; looking ahead and trying to establish a sound basis for international agreement creating reliable safeguards.

"The best possible atmosphere for the achievement of an international agreement could be achieved if America could say to the world: 'You see what sort of weapon we had but did not use. We are ready to renounce its use in the future if other nations join us in this renunciation and agree to the establishment of an efficient international control.'

"After such a demonstration, the weapon might perhaps be used against Japan if the sanction of the United Nations (and of public opinion at home) were obtained, perhaps after a preliminary ultimatum to Japan to surrender or at least to evacuate certain regions as an alternative to their total destruction.

"This may sound fantastic, but in nuclear weapons we have something entirely new in order of magnitude of destructive power, and if we want to capitalize fully on the advantage their possession gives us, we must use new and imaginative methods."

WHY WAS THE BOMB USED?

Summing up, the scientists expressed their conviction that a unilateral approach to the dropping of the bomb, even apart from moral considerations, however overwhelming, would almost inevitably result in unilateral action by other nations. And unilateralism in an atomic age was not merely a problem but a fatal disease. We would be undermining a possible common ground upon which common controls might later be built. As a corollary, we would be destroying whatever stand we might later decide to take on outlawing the use of atomic weapons in warfare. It would be naive to expect other nations to take such a plea seriously in view of our own lack of reticence in dropping the bomb when the war was on the verge of being won without it.

Why, then, did we drop it? Or, assuming that the use of the bomb was justified, why did we not demonstrate its power in a test under the auspices of the UN, on the basis of which an ultimatum would be issued to Japan—transferring the burden of responsibility to the Japanese themselves?

Whatever the answer, one thing seems likely: There was not enough time between July 16, when we knew at New Mexico that the bomb would work, and August 8, the Russian deadline date, for us to have set up the very complicated machinery of a test atomic bombing involving time-consuming problems of area preparations; invitations and arrangements for observers (the probability being that the transportation to the South Pacific would in itself exceed the time limit); issuance of an ultimatum and the conditions of fulfillment, even if a reply limit was set at only forty-eight hours or less—just to mention a few.

No; any test would have been impossible if the purpose was to knock Japan out before Russia came in—or at least before Russia could make anything other than a token of participation prior to a Japanese collapse.

It may be argued that this decision was justified, that it was a legitimate exercise of power politics in a rough-and-tumble world, that we thereby avoided a struggle for authority in Japan similar to what we have experienced in Germany and Italy, that unless we came out of the war with a decisive balance of power over Russia we would be in no position to checkmate Russian expansion.

There is a dangerous plausibility here—a plausibility as inseparable from the war system of sovereign nations as armaments are from armament races. It is the plausibility of power politics, of action leading to reaction, reaction leading to counter-reaction, and counter-reaction leading to war; of competitive systems of security rather than of workable world organization. It is a plausibility that rests on the flat assumption that war with Russia is inevitable, and that we should fight it at a time and under terms advantageous to us.

Such "plausibilities" are rejected by those who feel that the big job is to avert the next war, rather than to win it—even assuming that the next war will be worth winning, a somewhat dubious proposition. And they see no way to avert the next war other than through a world organization having the power to back up its decisions by law and relying upon preponderant force as needed. Such an organization would attempt to dispose of the fear-begetting-fear, provocation-begetting-provocation cycle; and to substitute in its place a central authority from which no member could withdraw or secede under any circumstances. It would automatically deprive potential aggressors of their traditional excuse for aggression—namely, their own encirclement and insecurity—and be strong enough to deal with them should a real threat arise.

It is possible, perhaps probable, that at the start not all nations would be willing to join such an authority, but so long as the overwhelming majority is willing to establish it, it will only be a matter of time before the others will find it impossible to remain outside. But assuming that any nation continues to stand aloof, the question for the rest of the world is whether that nation represents more of a threat outside a system of world law than it does inside world anarchy.

Meanwhile, no such world law exists, ınd the United States, which is in the best position—perhaps it is an obligatory posiion—to make the initial proposals looking oward the development of the United Nations into an authority with responsible ınd adequate power—the United States is naking no such proposals and seems conent to see the UN—born so auspiciously nd with such high hope—grow weaker ay by day for want of nourishing authorty to deal with the very questions that ive it its only reason for being. True, David had only a slingshot, but the UN acks even that in a world of pushbutton tomic warfare. There are no world poce, no world law, no world agencies whose decisions are binding, no authority ver the international instruments of eath.

HE LILIENTHAL REPORT

This is the general background against which the Acheson-Lilienthal "Report on he International Control of Atomic Energy" must be viewed, for the problem of tomic energy is synonymous with the roblem of world peace. It is therefore ignificant that the Report is even more oncerned with world policy than with merican policy; its recommendations ould have to be effective on a world scale they are to be effective at all.

Let us say forthwith that this Report ffers real encouragement in an otherwise iscouraging picture. More than that: it a refreshing display of sanity at a time hen the products of cerebral activity in igh station seem severely rationed. The ommercial publishers are to be commend-l for making it available for general stribution at low cost.

The Board of Consultants which prered this report was a diverse group of en, whether in terms of professional ackground or personality. Two members the group were businessmen; one was a hysicist, one a chemist, one a government lministrator. One trait, however, they all ad in common: They were strongly indidualistic and not generally addicted to e usual type of committee work or overly nd of committee techniques.

OW THE COMMITTEE UNCTIONED

If it is asked how such a group manged to get together on any report requirg strength, the answer may be that their ery individuality and their abhorrence the traditional committee ineptitude ade them determine at the start to byss all the old committee devices resultg in compromise rather than in a direct, ld approach to a problem. This is no ference on our part; it is based on seval conversations with one of the conltants.

"At the very first meeting," he said, "the oup agreed the subject was too important to be subjected to the hazards of the push-and-pull of the committee approach. And so, even before we studied the problem of atomic energy, we studied committee techniques — what the reasons were which made the committee system fail so often or come up so frequently with sterile compromises. It was a fascinating discussion we had that day—on semantics, dialectics, the art of persuasion, collaborative effort.

"It seemed to be fairly well agreed that most committees break down because many members come to their job with fully formed conclusions, having almost property rights in their own ideas, and spend all their time proposing and exhorting rather than listening and considering. It was inevitable that the old system would make for a clash of personalities even more than for a clash of ideas.

"Our first joint decision, then, was to liberate all our discussions from idea-possessiveness. No point would be argued down; we agreed that we would attack the problem inductively, working from the ground up, assembling all facts pertinent to the problem as a basis for conclusions, implied or implicit. We agreed that all questions coming up were to be considered as being brought up by the group as a whole rather than by any single member. If a member had an objection to any one point, it was to be regarded as something that troubled the group as a whole.

"We agreed, too, that we were not going to issue a watered-down report just for the sake of coming out with *a* report. We were not going to get into the usual type of barter system, trading off one pet idea against another, getting into committee 'deals' just for the sake of carrying off individual honors. We agreed that we would issue five reports if any of us felt that the group report lacked directness and honesty.

"You might call this a sort of search for individual and group objectivity. At the least, it meant that each of us was pledged to attempt to emancipate himself from the tyranny of his own ego. We were trying to create a collective wisdom.

"At first, it was hard to do this. Every now and then the discussions would break down just because one of us found it difficult to get used to the science of joint thinking and would lapse into the role of prosecutor or defendant. But little by little, the preconceived ideas dropped out; the clash of conflicting personalities became less and less apparent.

"We virtually lived together during the entire two months. When a point came up that could only be settled by first-hand observation at one of the atomic centers or at one of the laboratories—wherever it was—the entire group would bundle itself up and make the trip forthwith. Some of our best discussions, in fact, were on long plane trips. We found the air a particularly appropriate place to discuss problems that were literally out of this world."

It may seem that there is nothing very remarkable about all this and that such an approach should be taken for granted. Yet anyone familiar with the workings of the average government committee, with its sporadic meetings and erratic attendance; its half-formed ideas and incomplete discussions; the intrusion of personalities and personal considerations; and, finally, the habit of turning over all the undigested material to a secretary or counsel, who prepares for the chairman's signature a report which seems primarily designed to avoid offending any of the members of the committee; anyone who has has been through this will appreciate how really remarkable and worthy of emulation were the Lilienthal committee's techniques.

At the very least, these techniques were responsible for a report representing a piece of public service of the first order. Bear in mind that the Report was offered not as a formal statement of suggested policy but as a basis for public discussion and consideration. The consultants emphasize in an introduction that the Report is offered "not as a final plan, but as a place to begin, a foundation on which to build. Many questions that at later stages should and must be asked we have not touched upon at all."

On one count alone—its statement of the problem—the Report deserves to be read by every literate American. It begins by describing what the next war would mean to the United States. It makes the categorical assumption that there can be no military defense against atomic weapons. It asks Americans to recognize that our monopoly in atomic bombs will be short-lived, that within a very few years we can expect nuclear fission to figure in the armaments of almost all other major nations. It emphasizes the disadvantage of the United States with regard to a surprise attack. It sees no prospect of security against atomic warfare in a system based on international agreements relying on inspection and "similar police-like methods." It has little hope in outlawing the bomb by voluntary methods; this would place an "enormous pressure upon national good faith." It warns of the dangers of "national rivalries in the development of atomic energy readily convertible to destructive purposes."

The hard-hitting conclusion is that atomic energy is too dangerous a force

to be owned, operated, or developed by any sovereign nation.

This leads automatically to the next conclusion: atomic energy must be internationalized. But what type of internationalization? The United Nations? If so, do the United Nations have the necessary structural powers? What about nations which are outside the UN? If not, to what agency would any system of control be responsible?

All these questions were further complicated by several conditions which the consultants were apparently directed to take into account. One such condition was that the State Department was anxious to assure Congress that any plan of international control, should it fail, would still enable the United States to retain its "relatively secure position, compared to any other nation." Another such condition, specified in Mr. Acheson's introductory letter of transmittal, was that the United States would still be allowed to manufacture its atomic bombs after a plan of international control was put into operation, although "at some stage" such discontinuance would probably be required.

SOME CRITICISMS OF THE REPORT

Now these are of course impossible conditions. It is internationalization with a "but." It precludes any true internationalization of atomic energy or anything else. It might be possible to meet these conditions in such a way as to provide the appearance of internationalization, but the substance would be that of a most-favored-nation treaty—for the United States. All the nations in the world would be asked to surrender their sovereignty in the mining, processing, and manufacture of fissionable materials, but the United States would still be permitted to stockpile its own atomic bombs. Appealing and reassuring as this may sound in the Senate of the United States, it is as myopic as it is impractical. Are we to suppose that other nations would ever agree to such conditions? Or that, if they did agree, that they would not do everything possible to give themselves the same advantage that we feel our own national interests demand? It seems clear that any plan of control would be no more than a thin facade behind which all the old struggles for power—in today's terms, atomic power—would move inexorably to a climax.

Such conditions mean that this government, after two world wars, is still holding back on any measures of world organization with any real starch or workability. We are still unwilling to take the plunge, still unwilling to recognize that the central organization must be stronger than any of its members, still unwilling to back up our professions of international collaboration with the necessary authority.

The Lilienthal Report is obedient in that it does not specifically set aside the two conditions, yet the consultants do a very neat job of dramatizing the utter absurdity of allowing a large area of unilateralism to exist inside any world authority.

For it is a world authority that the consultants propose—a world Atomic Development Authority with unquestioned jurisdiction and power over world supplies and stocks of uranium and thorium—the only raw materials which, so far as scientists now know or can envision for the reasonable future, can be used for the release of atomic energy. The agency will have supreme authority over everything connected with fissionable materials —mining, manufacturing, inspecting, research, licensing, price-fixing, and sales.

Certainly the Report has flaws. We fail to see how a world authority could have the power called for in the field of atomic energy without a world organization having supra-national powers. We fail to see how it would be possible to operate what is in effect an agency of world government without a world government to back it up. We fail to see how sovereignty could be abrogated in one area, however critical, while all the other areas continued to operate under the old and incendiary sovereignties. We fail to see how it would be possible to separate the control of atomic energy from the control of war. We fail to see how it would be possible to set up yardsticks by which fissionable materials could be distributed equitably—in a world of grasping and competitive sovereignties. Would nations without uranium ores have purchasing rights under the plan?

By inference, at least, the Report itself admits these flaws. But its job was strictly limited to the question of atomic energy; and it perhaps had a right to take for granted that an adequate world organization would be developed out of the United Nations. What, otherwise, would be the source of authority? To what source would nations or individuals appeal for legitimate redress? Suppose one nation or coalition of nations walked out of the plan—for good or bad reasons? What action would be taken? Under what laws? In short, could or should the plan be operative without the machinery of justice and the power of justice?

The Report virtually admits, too, that the plan could not prevent an atomic war. The impression is clear that if a war broke out, individual nations would seize the ADA installations and facilities, which, together with its own plants working with denatured fissionable materials, could be used as the basis for an all-out production effort. So that within a number of months, atomic weapons might be in general use. But here, too, it must be remembered that the committee was given no authority to set up a world organization that could keep the peace.

In connection with this, however, Mr Lilienthal has pointed out that the plan could be effective in reducing the chances of surprise attack—the biggest single threat and dread of atomic warfare. There is a definite relationship, he adds, between reducing the chances of war, since the fear of surprise attack in an atomic armaments race might in itself be sufficient to bring on the next war.

CONCLUSIONS.

Despite all flaws, and despite conditions of unilateralism favoring the United States which the committee had to take into account, we believe it of the utmost importance that the Report be used as the basis for immediate discussion and action by this country. It provides a valid occasion for the United States to propose amendments to the United Nations Charter setting up the world atomic authority. Of even greater significance, it puts the challenge squarely up to the Administration to propose amendments to strengthen the UN itself to whatever degree is needed to make the ADA operable.

But if the ADA is set up without respect to basic and dangerous weaknesses within the structure of UN, then one of two things may happen as soon as people discover the absurdity of marking out atomic energy alone for control in a world which has the right to develop other methods of warfare perhaps even more destructive —such as the diffusion of plague germs against which there may be no immunization defenses; and as soon as people discover that the ADA must rise or fall with the organization behind it. One thing that might happen would be a surging popular demand for immediate and sweeping changes in UN to make it equal to the job before it. The only other thing that could happen would be that the ADA and the UN along with it, or rather behind it, would collapse in the most grotesque and tragic failure in history.

The most practicable way to avoid such a failure, and failure in this case is synonymous with war, is to work with fundamentals *now*, to dig right in and do the spade work *now*, to take on the seemingly impossible job of converting the United Nations into an organization invested with whatever power is necessary to keep the peace, *now*. And the best way to begin is by being sure that we, the American people, are willing to make the first proposal for a real pooling of sovereignty.

The Carnegie Draft Convention

. . . Legal Subcommittee, Carnegie Endowment for International Peace

George A. Finch, Chairman; Joseph P. Chamberlain, PercyE. Corbett, Malcolm W. Davis, Clyde Eagleton, Manley O. Hudson, Herbert L. May, James T. Shotwell, Edgar Turlington, Louis B. Sohn.

The Carnegie Endowment for Interna- ional Peace is one of the most active rivate groups working on problems of tomic energy (see Bulletin Nos. 3 and). It has previously issued an important eport on control of radioactive raw naterials, which was reprinted in con- ensed form in No. 6 of the Bulletin.

Below, we reprint a Draft Convention n the control of atomic energy, prepared y the legal subcommittee of the Carnegie 'ndowment Committee on Atomic Energy, nder the chairmanship of George A. 'inch. This draft has to be compared vith the plan outlined in the Acheson- ilienthal report, which has since been mbodied in the proposals made by Ba- uch to the UN Atomic Energy Commis- ion, and with plans proposed by other rivate study groups such as the Chicago 'raft Convention (Bulletin Nos. 8 and 2). We hope to be able to give a more etailed comparative analysis of the Car- egie plan in one of our future issues. n general, it gives less power and scope the international agencies than does e official American plan or the Chicago raft Convention, and leaves more free- om to national activities. Instead of out- wing atomic bombs altogether, it gives the Security Council the right to au- orize individual states to possess a cer- in number of bombs and to use them in d of action for the maintenance of ternational peace and security. *Ed.*

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he signatory States, desiring

to provide for all peoples security gainst the use of atomic weapons,

to assure to all peoples the advantages be derived from the control of atomic ergy and its use for peaceful purposes, nd

to organize and direct the cooperation international and national agencies for e achievement of these ends,

gree to the following Convention:

CHAPTER I.

RINCIPLES OF INTERNATIONAL AW AND THEIR IMPLEMENTATION

ARTICLE 1. The signatory States de- are the following to be principles of gen- al international law:

(a) The production, the possession, and the use of atomic weapons are prohibit- ed, except as authorized under Articles 2 and 4 of this Convention.

(b) The possession and the operation of plants which are exclusively suited for the production of atomic weapons are proribited, except as authorized under Article 2 of this Convention.

(c) The conduct of research and experimentation with respect to the military application of atomic energy is prohibited, except as authorized under Article 2 of this Convention.

(d) Each State has a duty to refrain from any violation of these prohibitions, and to take all the necessary legislative, administrative and police measures for the enforcement of these prohibitions within its territory.

ARTICLE 2. 1. For the maintenance of international peace and security in accordance with the provisions of the Charter of the United Nations and subject to such general regulations as may be adopted, the Security Council may give specific authorization to any signatory State

(a) to conduct, or to license the conduct of, research and experimentation with reference to the military application of atomic energy;

(b) to possess, to operate, or to license the operation of, plants which are exclusively suited for the production of atomic weapons;

(c) to produce, or to license the production of, atomic weapons; or

(d) to possess atomic weapons.

2. In aid of action under Chapter VII of the Charter of the United Nations, the Security Council may give specific authorization to any signatory State to use atomic weapons.

ARTICLE 3. A failure by any State to comply with the principles set forth in Article 1 may be found by the Security Council to be a threat to the peace, or a breach of the peace, and the Security Council may make recommendations or decide what measures shall be taken to maintain or restore international peace and security, in accordance with the provisions of Chapter VII of the Charter of the United Nations.

ARTICLE 4. Subject to the provisions of Article 51 of the Charter of the United Nations, the signatory States undertake to retaliate, immediately and with all the means at their disposal, against any State which resorts to the use of atomic weapons without a specific authorization of the Security Council.

CHAPTER II.

ORGANIZATION

A. International Atomic Energy Commission

ARTICLE 5. 1. An International Atomic Energy Commission is hereby established under the authority of the United Nations, to control the production, the distribution and the utilization of source materials[1] and of fissionable materials,[2] and to promote the utilization of atomic energy for peaceful purposes, as provided in this Convention.

2. The International Commission shall be composed of nine members, who shall serve for three-year terms, and who may be selected to succeed themselves.

3. Each State which is a permanent member of the Security Council shall select one member of the International Commission, and an alternate with power to act for the member when he is absent. Four members of the International Commission, and four alternates, shall be selected by the General Assembly. Vacancies shall be filled in the same manner as the original selection.

ARTICLE 6. 1. The International Commission shall adopt its own rules of procedure, including the method of selecting its President.

2. The Commission shall be so organized as to be able to function continuously, and the members of the Commission shall be bound, unless they are on leave or prevented from attending by illness or other serious reason duly explained to the President, to hold themselves permanently at the disposal of the Commission.

3. Each member of the International Commission shall have one vote.

4. Decisions of the International Commission shall be made by a majority of the members present and voting.

ARTICLE 7. 1. The International Commission shall establish a Board of Scientific and Technical Experts to act in an advisory capacity and to be consulted on scientific and technical matters.

2. The Board shall consist of fifteen members, of whom not more than two may be nationals of the same State.

3. The members of the Board shall be

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1 As the term is used in this Convention, "source materials" include uranium, thorium and any other materials which the International Commission declares to be peculiarly essential to the production of fissionable materials.

2 As the term is used in this Convention, "fissionable materials" include plutonium, uranium enriched in the isotope 235, any other material which the International Commission declares to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, and any other material artificially enriched by any of the foregoing. It does not include "source materials".

elected by the International Commission for six years and may be reelected; provided, however, that of the members elected at the first election, the terms of five members shall expire at the end of two years and the terms of five more members shall expire at the end of four years.

4. Before each election of the members of the Board, the International Commission shall consult competent scientific and technical bodies, national and international.

ARTICLE 8. 1. The International Commission may set up such committees and agencies, and it may maintain such offices, laboratories and plants, at it may deem necessary for the exercise of its powers under this Convention.

2. The International Commission may appoint its own staff, both technical and administrative.

3. The expenses of the International Commission shall be borne by the United Nations, in such manner as shall be decided by the General Assembly of the United Nations.

ARTICLE 9. 1. The International Commission shall posses full juridical personality in the territory of each of the signatory States and, in particular, it shall have capacity:

(a) to contract;

(b) to acquire and dispose of immovable and movable property;

(c) to conduct research and developmental and commercial activities; and

(d) to institute legal proceedings.

2. The International Commission shall have immunity from every form of judicial process.

3. The premises of the International Commission shall be inviolable; its property and assets shall be immune from seizure and from all interference by national authorities and shall be exempt from all taxation.

4. The members of the International Commission, their alternates, and the staff of the International Commission, when engaged on the business of the Commission, shall enjoy such privileges and immunities as are necessary for the independent exercise of their functions.

B. National Atomic Energy Commissions

ARTICLE 10. 1. Each signatory State agrees to establish a national atomic energy commission to regulate, subject to the control and supervision of the International Commission provided for in this Convention, all activities within its national territory connected with the production and utilization of source materials and of fissionable materials, and to facilitate the work of the International Commission within its territory.

2. Each national commission shall transmit to the International Commission monthly reports, promptly and in such form and detail as may be prescribed by the International Commission, concerning all activities within its national territory connected with the production, movement, and utilization of source materials and of fissionable materials.

3. The International Commission may request a national commission to supply any supplementary particulars of explanations in regard to its reports.

CHAPTER III.

GENERAL FUNCTIONS OF THE INTERNATIONAL COMMISSION

A. Research and Development

ARTICLE 11. 1. The International Commission shall establish programs of research and development to promote scientific and technical progress in the field of atomic energy, particularly with respect to

(a) nuclear processes;

(b) the theory and production of atomic energy;

(c) the utilization of fissionable and radioactive materials for medical, biological or health purposes;

(d) the utilization of fissionable and radioactive materials for industrial purposes; and

(e) the location and treatment of ores.

2. The International Commission may engage directly in such activities, and for this purpose it may maintain the laboratories and plants which it may deem to be required. Such laboratories and plants should, so far as may serve the purposes of the International Commission, be located in various countries and in different parts of the world.

3. Each signatory State agrees to permit the International Commission to maintain and operate such laboratories and plants in its territory, and to facilitate their use by the International Commission for research and developmental purposes.

4. The International Commission shall also encourage and lend aid to the conduct of national research and developmental activities by governmental and private agencies, and to this end it shall make availiable to them the appropriate quantities of fissionable materials and of radioactive byproducts.

B. Surveys

ARTICLE 12. 1. A general survey of deposits of source materials shall be conducted by the International Commission as soon as possible after its establishment. To facilitate such survey, each signatory State agrees to transmit to the International Commission, within three months after it inaugural meeting, all information in its possession with respect to the known deposits of source materials and the efforts being made to discover additional deposits

2. The International Commission shal have power to conduct geological survey within the territory of any State, for th purpose of ascertaining the existence, th location, and the content of deposits o source materials.

3. Each signatory State agrees to assis the International Commission in the con duct of such surveys, and to supply al relevant information which may be avail able, and to permit access for the purpos to any part of its territory by any means including access by air.

C. Dissemination of Information

ARTICLE 13. 1. Each national com mission shall assemble the basic scien tific information and the related technica information available within the nationa territory with respect to the productio and utilization of atomic energy, and i shall include such information in its month ly reports to the International Commis sion.

2. The International Commission sha arrange for the periodical publication o all information available to it, with re spect to the production and utilization o atomic energy.

D. Economic and Social Uses of Atomi Energy

ARTICLE 14. In cooperation with th Economic and Social Council of the Unite Nations, the International Commission ma initiate and conduct studies of the economi and social effects of the utilization of atom ic energy, and it may make recommenda tions on this subject to the signator States, to the General Assembly, and t any specialized agencies concerned.

E. Military Application of Atomic Energ

ARTICLE 15. 1. The International Com mission shall from time to time consu with the Military Staff Committee of th Security Council, with reference to th activities of the Commission.

2. In cooperation with the Military Sta Committee of the Security Council, th International Commission may initiate an conduct studies with respect to the militar application of atomic energy, and it ma make recommendations on the subject t the Security Council.

F. Periodical Reports

ARTICLE 16. 1. The International Com mission shall submit an annual report t the General Assembly and a quarterly r port to the Security Council, concuring i activities under this Convention.

2. All such reports by the Internation Commission shall be published immediat ly.

3. Each signatory State agrees to giv immediately full publicity within its te ritory to the reports of the Internation Commission.

;. Conduct of Inspections

ARTICLE 17. 1. The International Com-nission shall adopt general regulations oncerning the conduct of the inspections rovided for in this Convention, and the echniques to be employed.

2. Each signatory State agrees to issue o the officials of the International Com-nission such credentials as may be neces-ary for the carrying out of inspections.

3. Each national commission shall ap-oint one or more assessors who shall be onstantly at the disposal of the Inter-ational Commission for facilitating the vork of its officials within the national erritory. Assessors shall be entitled to ccompany the officials of the Internation-l Commission on inspections within the ational territory.

4. The officials of the International Com-nission shall not give orders to the local uthorities. The assistance which may be eeded from these authorities shall be equested through the intermediary of ne assessors, who shall be provided with he necessary powers for this purpose.

5. Neither the International Commis-ion nor its officials may make any dis-losure of trade secrets revealed by an nspection, such as those relating to tech-ical details of the production processes, roduction costs, profits, financial arrange-nents, and selling methods. The Inter-ational Commission shall adopt regula-ons for hearing complaints concerning lleged disclosures.

CHAPTER IV.

IEASURE OF CONTROL

. Mining

ARTICLE 18. 1. In agreement with the tate in whose territory a deposit of ource materials is located, the Internation-l Commission may acquire such deposit, nd engage directly in mining it or license ne mining of it under regulations for ccounting and inspection and for pur-hase by the International Commission of l source materials produced.

2. The International Commission shall ave power to inspect mines in the ter-tory of any State, for the purpose of scertaining the quantity and content of ource materials which are being or may e extracted.

3. The International Commission shall rovide for continuous inspection of all ining in each region in which significant eposits of source materials are known o exist, and it shall maintain a regional fice there for this purpose.

4. Each signatory State agrees to facil-ate the inspection by the International ommission of mines in its territory, and see that no impediment is placed in the ay of such inspection. To this end, each gnatory State shall require operators all mines within its territory to keep ch records as the International Com-ission may prescribe, with respect to the reserves, extraction, stockpiles, move-ment and sales of source materials. These records shall be open to the International Commission.

B. Production of Concentrates of Source Materials

ARTICLE 19. 1. The International Commission may maintain, operate or license in the territory of any State with the agreement of that State, facilities and plants for the production or segregation of concentrates[3] of source materials.

2. Each signatory State agrees to permit the production of concentrates of source materials within its territory only by the International Commission, or by its national commission, or under a production license issued by its national commission, and in the last case to require compliance with the terms of the license.

3. The International Commission shall make for each country a yearly estimate of the quantity of concentrates of source materials needed to assure an adequate supply for peaceful uses and for such uses as have been authorized by the Security Council under Article 2 of this Convention, and it shall fix from time to time a maximum production quota for each State which possesses facilities or plants for the production of such concentrates, and shall provide for the international distribution of such concentrates for peaceful purposes.

4. Each signatory State agrees to restrict the total amount of the production of concentrates of source materials by its national commission or under license issued by its national commission to the maximum production quota assigned to it by the International Commission.

5. Each signatory State agrees to require each holder of a production license to sell all his output of concentrates of source materials to its national commission, and to establish severe penalties for any failure to comply with this requirement.

6. Each signatory State agrees to require its national commission and each holder of a production license to conform to the regulations adopted by the International Commission with respect to the storage and movement of concentrates of source materials.

ARTICLE 20. 1. The International Commission shall have power to inspect in the territory of any State any facilities or plants which are, or may be, adapted for the production of concentrates, for the purpose of ascertaining whether they are being used for the production of concentrates of source materials. Each signatory State agrees to facilitate such inspection in its territory, and to see that no impediment is placed in its way.

2. The International Commission shall assign one or more officials to each facility or plant used for the production of concentrates of source materials, and such officials shall be permitted to enquire into all activities of the facility or plant and to examine its books and records.

3. The International Commission shall make regulations for the storage and movement of source materials within a country.

4. Each national commission shall transmit to the International Commission monthly reports on the amounts of concentrates of source materials produced or acquired by it, and on its stockpiles of such concentrates.

ARTICLE 21. 1. A national commission may transfer concentrates of source materials only to the International Commission or, with the specific authorization of the International Commission, to a national commission of another State.

2. Whenever the amount of concentrates in the possession of a national commission exceeds the estimate of its needs made by the International Commission under paragraph 3 of Article 19, the national commission shall immediately transfer the excess amount to the International Commission.

3. After satisfying its own requirements and the requirements of private and governmental agencies engaged in research and developmental activities, the International Commission shall distribute the remaining concentrates of source materials in its possession among the national commissions in proportion to their needs as established in the yearly estimate made under paragraph 3 of Article 19.

4. The International Commission shall adopt detailed regulations for the execution of this Article.

C. Production of Fissionable Materials

ARTICLE 22. 1. The International Commission may maintain and operate, in the territory of any State with the agreement of that State, one or more plants for the production of fissionable materials from concenrates, or for the renaturing[4] of fissionable materials after they have been denatured.

2. Each signatory State agrees to prohibit the construction within its territory of plants designed to produce or renature fissionable materials, except by the International Commission or with its authorization. In giving such authorization, the International Commission may prescribe the general specifications for the construction of each plant.

[3] As the term is used in this Convention, "concentrates of source materials" include source materials in such concentration and in such form as the International Commission may by regulation determine from time to time.

[4] As the terms are used in this Convention, "denatured materials" include fissionable materials which have been rendered not readily convertible into explosive materials, and "renatured materials" include fissionable materials which have been reconevrted into materials readily usable for the manufacture of explosive materials. These terms are subject to definition from time to time by the International Commission.

3. Each signatory State agrees that all plants in its territory which are adapted for the production or renaturing of fissionable materials and which are not maintained and operated by the International Commission, shall be operated directly by its national commission.

4. The International Commission shall have power to inspect in the territory of any State any plants which are, or may be, adapted for the production or renaturing of fissionable materials, for the purpose of ascertaining whether these plants are being used for such production or renaturing. Each signatory State agrees to facilitate such inspection in its territory, and to see that no impediment is placed in its way.

ARTICLE 23. 1. The International Commission shall make a yearly estimate of the quantities of fissionable materials needed for peaceful uses and for such uses as have been authorized by the Security Council under Article 2 of this Convention, and it shall fix from time to time a maximum production quota for each national commission which possesses plants for the production of such materials.

2. Each signatory State agrees to restrict the total amount of the production of fissionable materials by its national commission to the maximum production quota assigned to it by the International Commission.

3. Except upon a specific authorization otherwise by the International Commission, each national commission shall denature as promptly as possible all fissionable materials produced in its plants, in accordance with regulations prescribed by the International Commission.

4. The International Commission shall assign one or more officials to each plant producing fissionable materials, and such officials shall be permitted to enquire into all activities of the plant and to examine its books and records. Upon request of the national commission, the International Commission may authorize such officials to take part in the operation of a plant and to give assistance in the conduct of the plant's activities.

5. Each national commission shall conform to the regulations adopted by the International Commission with respect to the storage and movement of fissionable materials.

6. Each national commission shall submit to the International Commission monthly reports on the amounts of fissionable materials produced and on the amounts and stages of development of stocks in its possession.

ARTICLE 24. 1. A national commission may transfer fissionable materials only to the International Commission or, with the specific authorization of the International Commission, to a national commission of another State.

2. Whenever the amount of fissionable materials in the possession of a national commission exceeds the estimate of its needs made by the International Commission under paragraph 1 of Article 23, the national commission shall immediately transfer the excess amount to the International Commission.

3. After satisfying its own requirements and the requirements of private and governmental agencies engaged in research and developmental activities, the International Commission shall distribute the remaining fissionable materials in its possession among the national commissions in proportion to their needs as established in the yearly estimate made under paragraph 1 of Article 23.

4. The International Commission shall adopt detailed regulations for the execution of Article 24.

D. Lease of Denatured Materials

ARTICLE 25. 1. A national commission may lease denatured fissionable materials to industrial establishments, under conditions to be prescribed by the International Commission. Monthly reports of all such leases shall be made by the national commissions to the International Commission.

2. The International Commission shall have power to inspect in the territory of any State any establishment which is engaged in the use of denatured fissionable materials. Each signatory State agrees to facilitate such inspection in its territory, and to see that no impediment is placed in its way.

E. Research and Development Activities

ARTICLE 26. 1. Each national commission shall make quarterly reports to the International Commission concerning the scope and character of the research and developmental activities carried on in the national territory by governmental or private agencies, with respect to the production and utilization of fissionable and radioactive materials.

2. The International Commission shall have power to inspect in the territory of any State any laboratories or plants for the purpose of ascertaining whether these laboratories or plants are engaged in such research or developmental activities. Each signatory State agrees to facilitate such inspection in its territory and to see that no impediment is placed in its way.

F. Production of Atomic Weapons

ARTICLE 27. 1. Where the Security Council has authorized a signatory State to possess, to operate, or to license the operation of, a plant exclusively suited for the production of atomic weapons, the International Commission shall assign one or more officials to such plant for the purpose of ascertaining whether the conditions set by the Security Counci are being complied with. Such official shall be permitted freely to enquire an examine into all activities of the plan and to examine its books and records.

2. The International Commission shal have power to inspect in the territory o any State any plants which are, or ma be, adapted for the production of atomi weapons or parts of atomic weapons, fo the purpose of ascertaining whether the are engaged in such production. Eac signatory State agrees to facilitate suc inspection in its territory, and to se that no impediment is placed in its wa

CHAPTER V.

PROCEDURE IN CASE OF INFRINGEMENT

A. Investigations

ARTICLE 28. 1. The International Com mission, when it is informed by any Stat of an infringement of any of the pro visions of this Convention, or when i has other reasons to suspect that an in fringement has occurred or is about t occur, shall at once proceed to an investi gation of the situation. To this end, i shall invite the State within the territor of which the alleged or suspected in fringement has occurred, to supply ex planations.

2. The International Commission ma if it is deemed necessary, conduct special investigation on the spot, an each signatory State agrees to facilitat such an investigation in its territory, an to see that no impediment is placed i its way.

3. The International Commission sha as soon as possible submit a special re port informing the Security Council o the alleged or suspected infringemen of the explanations supplied by the Stat concerned, and of the steps taken by th International Commission to investigat the situation. The International Com mission may include in the special re port its evaluation of the gravity of th situation, as well as its recommendation for action by the Security Council, unde Chapter VII of the Charter of the Unite Nations.

4. Each such special report by the Inte national Commission shall be immed ately communicated to all the signator States, and it shall be made public a soon as possible.

B. Provisional Measures

ARTICLE 29. Upon receipt of a not fication that the International Commi sion is conducting an investigation wit respect to an alleged or suspected in fringement of the Convention, the sig natory States undertake to suspend

(a) all export to the State concern of source materials, of fissionable ma terials, and of machinery and applianc for the production of such materials;

(b) all transit through the territories nder their jurisdiction of such materials, achinery and appliances destined for the tate concerned; and

(c) all transport on board vessels or irplanes registered in their respective erritories of such materials, machinery nd appliances destined for the State oncerned.

. Special Quotas

ARTICLE 30. The International Com-ission may, when it has reached the onclusion that an infringement has ccurred in the territory of any signatory tate, proceed immediately to readjust ne annual quotas assigned to any other gnatory State under Articles 19 and 3 of this Convention.

. Obstacles Offered by States Not arties to the Convention

ARTICLE 31. The International Com-ission may at any time bring to the tention of the Security Council, by eans of a special report, the existence ithin the territory of a State not a arty to this Convention of conditions hich seem to offer obstacles to the re-ization of the purposes of this Con-ention; it may also make recommenda-ons for action by the Security Council nder Chapter VII of the Charter of the nited Nations.

CHAPTER VI.

RANSITIONAL PROVISIONS

ARTICLE 32. A signatory State shall t be required to permit in its territory

(a) inspection of mines, under Article , and inspection of plants for the pro-action of concentrates of source ma-rials, under Article 20, until the Inter-tional Commission has certified that it s completed the general survey provided r in Article 12;

(b) inspection of plants for the pro-ction or renaturing of fissionable ma-rials, and of research and develop-ental activities, under Articles 22, 23, and 26, until the International Com-ission has certified that it has estab-hed the quotas provided for in Article , and that the system of quotas and spections provided for in Articles 19, and 21 has functioned successfully r a period of (x) months;

(c) inspection of plants for the pro-ction of atomic weapons, under Arti-27, until the International Commission s certified that the system of quotas d inspections provided for in Articles , 23, 24, 25 and 26 has functioned suc-ssfully for a period of (x) months;

ARTICLE 33. Each signatory State rees to transmit to the International mmission all information it may possess

(a) with respect to the number, loca-n and capacity of the plants within territory adapted for the production of concentrates of source materials, and with respect to its stockpiles of such concentrates, within (x) months after the inaugural meeting of the International Commission;

(b) with respect to the number, location and capacity of the plants within its territory designed to produce or renature fissionable materials, and with respect to its stockpiles of such materials, within (x) months after the International Commission has issued the certificate referred to in Article 32 (a);

(c) with respect to technical methods of producing, denaturing and utilizing fissionable materials, within (x) months after the International Commission has issued the certificate referred to in Article 32(b);

(d) with respect to the number and nature of the atomic weapons, and the number, location and capacity of the plants exclusively suited for the production of such weapons, which were in its possession at the time of the issuance by the International Commission of the certificate referred to in Article 32 (c), within (x) months after that certificate has been issued.

ARTICLE 34. 1. Until the first quotas have been established by the International Commission under Article 19, any signatory State may continue to produce concentrates of source materials in amounts not exceeding the amounts which it produced during the twelve months preceding the signature of this Convention.

2. Until the first quotas have been established by the International Commission under Article 23, any signatory State may continue to produce fissionable materials in amounts not exceeding the amounts which it produced during the twelve months preceding the signature of this Convention.

ARTICLE 35. 1. A signatory State may continue to possess, without authorization by the Security Council under Article 2, any atomic weapons which are in its possession on the date of the entry into force of this Convention; but after the issuance by the International Commission of the certificate referred to in Article 32(c), each signatory State shall destroy or transfer such of these atomic weapons as the Security Council may direct.

2. A signatory State may continue to possess, without authorization of the Security Council under Article 2, any plants exclusively suited for the production of atomic weapons which are in its possession on the date of the entry into force of this Convention; but after the issuance by the International Commission of the certificate referred to in Article 32(c), each signatory State shall destroy such of these plants as the Security Council may direct.

CHAPTER VII.

FORMAL PROVISIONS

ARTICLE 36. 1. Amendments to this Convention shall enter into force for all States parties when they have been adopted by a vote of two-thirds of the members of the General Assembly of the United Nations and ratified in accordance with their respective constitutional processes by two-thirds of the States parties, including all the States named in paragraph 3 of Article 37.

2. The conditions under which a State which is a party to the Convention but is not a Member of the United Nations may participate in the adoption of amendments shall be laid down by the General Assembly of the United Nations upon recommendation of the Security Council.

3. The International Commission shall have power to prepare and propose amendments to the Convention, through written communication to the Secretary-General of the United Nations, for consideration in conformity with paragraph 1 of this Article.

ARTICLE 37. 1. This Convention shall remain open for signature on behalf of any Member of the United Nations, and on behalf of any non-member State to which a copy thereof is communicated for the purposes by the Security Council of the United Nations.

2. The Convention is subject to ratification by the signatory States in accordance with their respective constitutional processes. The ratifications shall be deposited with the Secretary-General of the United Nations, who shall notify all the signatory States of each deposit.

3. The Convention shall enter into force upon the deposit of the ratifications of a majority of the signatory States, including Belgium, Brazil, Canada, China, Czechoslovakia, France, India, the Union of South Africa, the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland, and the United States of America. A protocol of ratifications deposited shall thereupon be drawn up by the Secretary-General of the United Nations who shall communicate copies thereof to all the signatory States.

4. For any State signatory to the Convention which ratifies it after it has entered into force, the Convention shall enter into force on the date of the deposit of its instrument of ratification.

The Draft Convention is printed in full in this issue. For an extensive introduction couched in non-legal terminology see the complete Report entitled Utilization and Control of Atomic Energy published by the Carnegie Endowment for International Peace.

The Availability of Radioactive Isotopes

. . . . . . Announced by the Manhattan Projec

Production of tracer and therapeutic radioisotopes has been heralded as one of the great peacetime contributions of the uranium chain-reacting pile. This use of the pile will unquestionably be rich in scientific, medical, and technological applications.

Manhattan Project scientific, technical and administrative personnel have, since the inception of the pile, been cognizant of its peacetime potentialities and have, since the end of the war, been active in attempting to realize these opportunities. Since, however, war-built piles and wartime researches had other objectives, a considerable transition in researches, developments, and operations connected with piles must be effected before the supply of radioisotopes can begin to meet the demand.

COMMENTS ON AVAILABILITY OF RADIOISOTOPES

(1) A pile cannot make the extensive variety of radioisotopes producible with the cyclotron because the cyclotron makes use of a much greater diversity in energy and type of nuclear bombarding projectiles. Present piles are copious sources of low-energy neutrons, which can give rise to large yeilds only of isotopes produced by (n,f) and (n,gamma) processes.

(2) Although large numbers of radioisotopes are produced in abundance by the fission of uranium in the piles, their availability is limited by the difficulties in isolating them. It has not yet been found feasible to remove individual fission products from waste solutions of the plutonium extraction process. Most of the fission products being made available are not salvaged by-products of the plutonium process but are ineach case items requiring special production from unprocessed irradiated uranium.

(3) Most of the radioisotopes in greatest demand, such as C 14, S 35, and P 32, must be produced by the irradiation of materials foreign to the pile. Existing piles were not designed for this purpose.

(4) Although a pile is a copious source of neutrons, it is not a limitless source. It is possible to load a pile for nonfission product radioisotope production only up to the limit at which so many neutrons are absorbed in the introduced material that the chain reaction ceases even though the control rods are withdrawn as far as feasible. With available pile facilities, this limit does not permit the production of a sufficient quantity and quality of many radioisotopes to meet anticipated national demands. To accomplish this it would very likely be necessary to build piles especially designed for the purpose.

(5) Technical problems involved in the irradiation of some materials have been, and will continue to be, responsible for delays in making certain isotopes available by routine irradiation. Examples of such problems are: (a) proper canning of the material to prevent rupture of the container by its internal action or by the external action of the coalant, with consequent loss of the material and damage to the pile; (b) careful purification to prevent loss of neutrons by absorption in impurities as well as undesirable radioactivity in the irradiated material; and (c) proper distribution of the material throughout the pile to prevent local overheating or undesirable regulation characteristics of the piles.

ORGANIZATION FOR ALLOCATION AND DISTRIBUTION

In accordance with the established custom of the Manhattan Project of seeking competent outside advice and aid on vital scientific matters, such as nonproject distribution of isotopes, Maj. Gen. L. R. Groves asked the president of the National Academy of Science to nominate a representative committee of outstanding scientists to recommend policies and aid in establishing arrangements for a desirable distribution of those tracer and therapeutic isotopes available from Manhattan Project facilities. An interim Advisory Committee on Isotope Distribution Policy was formed. Two representatives being chosen from each of the major fields of isotope application: Physics—Lee A. DuBridge (chairman), head, Physics Department, University of Rochester, and president-elect of California Institute of Technology, Pasadena; and Merle A. Tuve, head, Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D. C.; Chemistry—Linus Pauling, director, Gates and Crellin Chemistry Laboratories, California Institute of Technology; and Vincent du Vigneaud, head of the Department of Biochemistry, Cornell University Medical College, New York City; Medicine—Cornelius P. Rhoads, director of Memorial Hospital, New York City, and chairman of the Committee on Growth of the National Research Council; and Cecil J. Watson, University of Minnesota Medical School, head of the Department of Medicine, Minneapolis; Biology—Raymond E. Zirkle, professor of botany and director of the Institute for Biophysics and Radiobiology, University of Chicago, Chicago, Illinois; and A. Baird Hastings, head of the Department of Biological Chemistry, Harvard University Medical School, Cambridge; Applied Science—Zay Jeffries, vice-president and manager of Chemicals Depart ment, General Electric Company, Pitts field, Massachusetts; and L. F. Curtis chief of the Radioactivity Section, Nation al Bureau of Standards, Washington, I C. Paul C. Aebersold,chief of the Isotope Branch, Research Division, Manhatta District, was chosen acting secretary t coordinate the efforts of the Committe and to effect liaison with the Project.

The recommendations of this Committe on a suitable interim mechanism for alloca tion and distribution have been adopte without modification. This mechanism i as follows:

(1) All requests will be submitted t the Isotopes Branch, Research Divisio Manhattan District, where each reques will be reviewed with regard to all tech nical questions affecting the requeste and the Project. This initial review will b made by a group of scientists in the Pro ject who have had much experience in th production of radioisotopes and in technica matters concerned with their use.

(2) Nonproject requests will then b referred to an Advisory Subcommittee o Allocation and Distribution, which ha been appointed by Gen. Groves on th nominations of the Distribution Polic Committee. This Subcommittee will hav the responsibility of advising on the a location and distribution of isotopes a cording to the scientific value of the i tended application and the qualificatio of the requester. It will operate under th supervision of the Distribution Polic Committee and in conformity with its a proved policies. Its members are: K. Bainbridge (physics), Harvard Universit chairman; J. W. Kennedy (chemistry Washington University, St. Louis; J. Hamilton (biology and medicine), Unive sity of California; P. C. Aebersold (bi physics), Manhattan District, secretary

(3) Each request for material for u in human beings will be referred by th Subcommittee on Allocation and Distrib tion to a Subcommittee on Human Applic tion, which was similarly nominated a appointed. This Subcommittee will ha final veto power on any distribution su gested for human application. Its me bers, chosen from among radiologists a clinicians experienced in radioisotope us are: Andrew H. Dowdy, University Rochester, chairman; H. L. Friedell, We tern reserve University; G. Failla, Colu bia University.

(4) Small Panels of Consultants, no inated by the Policy Committee from number of specialized fields of possib isotope application and from various r gions of the Nation, will be available

visers on scientific matters connected th requests.

(5) Manhattan Project personnel have t been excluded from membership in any the nonproject advisory groups. In any cases their membership has been rongly advocated by the Distribution licy Committee.

(6) Effective liaison will be maintained tween the Isotopes Branch of the Manttan District Research Division, which tially receives and finally effects disbution on nonproject isotope requests, d the associated advisory groups whose nctions are set forth above.

RINCIPLES OF ALLOCATION ND DISTRIBUTION

In establishing initial policies on the tribution of scarce materials, the terion used has been the maximum nefit to the national welfare, due coneration being given to the limited nount of available material. The initial licies adopted are:

(1) Isotopes will be made available to ividuals only through qualified instiions. The administration of the intution will make the necessary finanl and legal arrangements, but the matel will be allotted for the uses specified the request.

2) Secondary distribution of isotopes l not be sanctioned unless indicated l authorized under the original request subsequently in writing through the epted channels for requests.

3) The initial order of priority adopted the allocation of materials and of protion effort is established according to ended use of the material, as follows: publishable researches in the fundantal sciences, including human tracer plications, requiring relatively small nples; (b) therapeutic, diagnostic, and cer applications in human beings and blishable researches in the fundamental ences requiring larger samples; (c) ining and education by accredited incutions in the techniques and applicans of radioisotopes; and (d) publishable earches in the applied sciences. Alloion of material for researches which not to be published or for routine nmercial applications was considered the Distribution Policy Committee not fall within its responsibilities. Alloion for routine commercial applications l be deferred until experience is gained h supplying the research needs preusly mentioned. Special groups may n be established to advise on such alloion.

PRODUCTION AND DISTRIBUTION ARRANGEMENTS WITHIN THE PROJECT

As indicated in the section on availlity, none of the separate purified radioisotopes is in routine operational production. In some cases research groups have progressed only to the point of investigating how irradiations can best be performed to create a given isotope and how to isolate the isotope in small amounts. In other cases methods are under investigation in development groups for increasing the scale of irradiation and chemical processing. In a few cases it has now become possible to start placing irradiations and chemical processing into the hands of technical operations groups for routine "production."

Research into methods of small-scale creation of most of the isotopes took place widely before the establishment of the Project; since then, it has been carried on extensively by project laboratories engaged in nuclear research. Thus, credit for the results of research on radioisotopes is shared by many nonproject and project personnel. Most of the research within the Project in this regard has been done by nuclear physics and radiochemistry groups at Clinton Laboratories at Oak Ridge, at the Radiation Laboratory of the University of California, and at the Metallurgical and Argonne Laboratories of the University of Chicago.

The present "experimental-lot production" has been carried on largely by the Clinton Laboratories, which since July 1945 have been administered by the Monsanto Chemical Company. In the case of several isotopes in great demand, the Argonne Laboratory has cooperated in preparing materials in proper form for irradiation at Hanford and in testing the results. The Du Pont Company, operators of the Hanford Plant, has cooperated in making irradiations of materials possible at Hanford. The Monsanto Chemical Company has agreed to initiate the routine production of nationally demanded radioisotopes and to distribute them from the Clinton Laboratories under District Administration.

A Manhattan Project Technical Advisory Committee on Isotopes has been active in maintaining liaison between major laboratories of the Project on (1) production and distribution matters concerned with the national distribution program and (2) developments in radioisotope techniques and applications. This Committee is composed as follows: J. R. Coe, W. E. Cohn, R. McCullough, A. H. Snell, and K. Z. Morgan, of the Clinton Laboratories; W. H. Zinn, W. F. Libby, and R. E. Zirkle, of the Argonne and Metallurgical Laboratories; J. G. Hamilton, B. J. Moyer, and R. E. Connick, of the University of California Radiation Laboratory; J. H. Manley and R. Taschek, of the Los Alamos Scientific Laboratories; and, in regard to concentrated stable isotopes, H. L. Hull and C. E. Larson, of the Tennessee Eastman Corporation, Oak Ridge.

DETAILS OF RADIOISOTOPE AVAILABILITY[1]

Pile-produced Radioisotopes

Radioactive isotopes are created in chain-reacting piles by two processes: (1) the fission of U 235 nuclei, which maintains the chain reaction, and (2) neutron absorption by nonfissionable nuclei placed in the pile for the purpose. The former—the so-called "fission products"—exist as a mixture of many radioactive species, each free of significant amounts of stable (carrier) isotopes, in a large amount of the parent substance, uranium. The desired radioisotope must subsequently be separated from uranium and from the other fission products, as well as from any neptunium and plutonium formed by neutron capture in U 238. In the chemical process actually used, the fission products are separated from the mixture either as individual radioactive species or as groups of species.

The Fission Products

The methods now in operation for the preparation of fission-product radioisotopes were developed to meet certain definite specifications, which in turn were set by the biological work in which the radioactive materials were to be used. These specifications called for 0.1—1.0 curie[2] amounts of each of the major fission products in carrier-free, essentially solid-free (less than 10 mg./curie) form, and radiochemically pure (more than 90—98 percent, depending on the species); smaller or less pure amounts of minor species were also required. The radiation intensities involved in working with mixtures of fission products at the curie level required the invention and use of chemical processes which were remotely controlled from behind specially constructed lead and concrete barriers and were economical of material. For these reasons the existing processes and equipment are not suited to isolate fission products in forms radically different from those listed. However, since these methods permit the isolation without carrier of nearly every fission product of half-life from 1 week to 30 years and occurring in significant amount, this inflexibility is not considered to be a handicap.

Inasmuch as a routine production system, with attendant control and standards, does not exist, *no guarantees of radiochemical purity or other such characteristic of any entry in any table may be made*, although every effort will be made

[1] Only those radioisotopes of half-life greater than 12 hours are considered.

[2] The curie is here defined as 3.7×10^{10} disintegrations/second.

to turn out as high a quality of material as possible. Information relating to the known characteristics of any preparation will be furnished.

Nonfission Radioisotopes

(1) *Non-carrier-free radioisotopes; simple (n,gamma) reactions.* The most prominent reaction is simple neutron absorption, yielding a radioactive element isotopic with the parent element. This is the (n,gamma) reaction, which differs from transmutation and fission reactions in that carrier-free material is not produced (except in those few cases where a radioactive chain is begun).

To obtain an isotope of this kind involves the insertion of the element, in a suitable form[3] into the pile and its subsequent removal. Even though in some cases (n,p) radiocontaminants are produced along with the desired (n, gamma)-induced radioisotope, no chemical separation process on the active material will be done prior to shipping (hence the term "service irradiation" to describe such an activation). In order to utilize the available facilities most efficiently, these materials will be exposed in the same containers in which they will be shipped, and only certain quantities will be irradiated.

(2) *Carrier-free radioisotopes.* Transmutation reactions yield radioisotopes which differ chemically from their parents and hence exist *without*[4] stable isotopic "carrier." Only a small number of elements are known to undergo (n,p), (n,a), etc. reactions to any appreciable degree in the pile; however, the few which do yield some of the most important radioelements. In addition to these types, in which transmutations are effected, there is a group of (n, gamma)-induced decay chains which can be utilized to yield carrier-free material. In this case a radioisotope produced by a (n, gamma) reaction decays to a radioactive daughter which is nonisotopic with its parent and with the source material.

A separation of the desired active species from the stable parent and from any (n, gamma)-induced radioisotopes of this parent must usually be made before use. Since the parent exists in bulk and there is often formed a large amount of radioactive material which is isotopic with the parent, the processing is not always a simple matter. The same considerations hold in the case of daughters of neutron-induced decay chains.

[3] In many cases it is advisable to irradiate elements in the form of a compound. The particular compound selected must be such as to lend itself to irradiation under the expected pile conditions. Undesirable radioactive specis and unsatisfactory containers must be avoided. For these and other reasons, the materials to be exposed in the pile for radioisotope production will usually be supplied and packaged by the Project.

[4] Except for impurities below detectable levels.

Again, because of the desire to make available the greatest number of radioisotopes, *such carrier-free species will usually be supplied in the irradiated material, unseparated from the parent and radioisotopes of the parent.* In these cases, as in all others, any pertinent experience in a particular separation will be made available. In a few cases, where the element is rare or where the separation is too hazardous to be accomplished, without special facilities, only separated material will be supplied.

PILE IRRADIATION SERVICES FOR OTHER THAN RADIOISOTOPE PRODUCTION

Materials to be exposed in the pile for radioisotope production will usually be supplied and packaged by the Project. The reasons for this are: (1) to insure that materials and containers introduced into the pile for the desired radioisotope production have minimal parasitic neutron absorption and minimal subsequent radioactivity, and (2 to avoid the possibility of loss of the irradiated material or of danger to the operation of the pile.

Requests for special irradiations, in which the requester desires to furnish the material, may arise because of: (1) other intended purposes than radioisotope production or (2) especially prepared or very rare materials. Such irradiations may require special handling which will be difficult to arrange during the inauguration period of the radioisotope distribution program. When sufficient experience has been gained in handling the normal irradiations and when a scale of charges is determined, special irradiation services may be announced.

AVAILABILITY OF CONCENTRATED STABLE ISOTOPES

In answer to numerous inquiries some brief comments are in order regarding the Project's ability to furnish concentrated stable isotopes. Arrangements have been completed thus far for the production, allocation, and sale of radioisotopes only. It may require considerable time to arrange these matters for such concentrated stable isotopes as may become available in excess of project needs.

The situation in regard to availability is now as follows:

(1) *Deuterium.* There is no heavy water or H 2 available.

(2) *Boron* 10. Small amounts of highly concentrated B 10 may be available for special neutron counter purposes. Prices and distribution mechanism are yet to be determined. These will be announced when arranged.

(3) *Carbon* 13. This isotope is mentioned separately only because of the wide interest in it for tracer purposes, particularly in organic chemistry and biology. There are no project faciliti which can at present be converted t concentrate C 13 in production amoun without great expense both in the co version of equipment and in operatio The cost of C 13 based on operational e penses alone would be considerably high than costs quoted for C 13 concentrat by chemical exchange methods.

(4) *Isotopes of elements* 3 *to* 82. Sma experimental lots of isotopes of no gaseous elements have been concentrat for project nuclear researches usi electromagnetic pilot plant facilities the Tennessee Eastman Corporation Oak Ridge. Studies have only recent begun on production costs and on the o tainable quality and quantity of conce trated materials. In general, productio is quite expensive, and it is difficult achieve the high isotopic purity desir for many nuclear studies. Arrangemen may be formulated for nonproject di tribution of experimental lots after mo experience has been gained with conce tration and assay methods and aft project needs become more clear.

As the situation warrants, announc ments will be made concerning the ava ability of concentrated stable isotopes.

CHARGES

Charges will be made for irradiat materials and processed isotopes, as is t case for many widely useful products r sulting from other research efforts. Pen ing experience, a reasonable charge considered to be one based on the "ou of-pocket" operational expenses necess tated by the nonproject production a service program. Charges will not inclu costs of rental, or construction of pla and major facilities or of research a development directed toward the suppl ing of isotopes in general. The Proje will supply the major facilities and d velop the production methods, but w assess a charge for the additional runni expenses of man power and materials i curred by the filling of nonproject r quests. Shipping expenses will be pa by the requester. Details of these a rangements and the prices to be charg may be obtained upon request from t Isotopes Branch of the Manhattan Distri Research Division.

MECHANISM FOR MAKING REQUESTS

As explained in the section on "Pri ciples of Allocatoin and Distribution radioactive materials will not initially distributed directly to private individua but only to accredited institutions or o ganizations. However, materials will allocated to an individual or a departme for the specific uses proposed in the r quest.

A request may be initiated by a respo sible applicant in an accredited instit

(Continued on Page 24)

he Status of Domestic Legislation . . . .

ı June 18, the House Military Affairs mittee amended the McMahon Bill to ide for the inclusion of two military in the proposed five-member Commis- for the Control of Atomic Energy.

ne committee also approved an amend- t specifying that the Director of the sion of Military Application in the nission should be a member of the ed forces.

s amended by the House committee, McMahon bill would go far beyond the -Johnson bill in allowing military esentation. In addition to the new isions for two military men and the ary director, it also provides for a ary liaison committee of an unspeci- number of Army and Navy officers.

epresentative Charles H. Elston, Re- ican of Illinois, obtained approval first n amendment for at least one military ber on the commission. Then Repre- ative Thomas E. Martin, Republican, owa, offered another providing for at two, and it was adopted. Mr. Martin rporated his amendment in a clause ing the legal barriers preventing mil- officers from collecting their salar- while serving with civilian Government cies.

r. Elston failed in an effort to make iaison committee a one-way body in- l of a two-way. As provided in the ahon bill, the commission and the nittee were to keep each other mutu- informed on all their activities. Mr. on proposed that the liaison commit- eed not inform the commission of all ctivities, particularly on atomic wea- research.

so defeated was an amendment that d have made possible the appointment ilitary men on the nine-man civilian sory committee provided in the Mc- on bill.

nother amendment that failed would struck at the policy statement in the ahon bill which authorizes the recip- exchange of atomic information.

hile the bill did not say so, opponents e provisions interpret it as meaning ange with foreign countries. They the position that no country had in- ation worth exchanging with the ed States.

June 19, the House Military Affairs nittee approved an amendment that d permit the Army, with Presidential ority, to manufacture atomic bombs. here the bill conferred authority on President to direct the commission to a: atomic weapons to the armed s, the committee added the phrase "or thorize the armed forces to manufac- produce, or acquire any equipment or device utilizing fissionable material or atomic energy as a military weapon."

Through this change, some members pointed out, the Army could obtain authority to continue operation of the atomic bomb plants now operated by the Manhattan District of the Corps of Engineers.

Mr. May, while opposed to the bill, had hoped to report it to the floor promptly for debate on the amendments there. He said that the committee had considered about two-thirds of the McMahon bill, which may go to the House for final action next week.

Proponents of the McMahon bill, which was unanimously passed by the Senate Atomic Energy Committee and the Senate itself, plan a hard fight on the floor and in conference to defeat the amendments which would give military officers far more influence in the commission than the controversial May-Johnson bill.

* * *

The National Committee for the Civilian Control of Atomic Energy issued a statement which declares that the Military Committee action "disregarded the specific recommendations of the President" and military leaders "and of prominent citizens from all walks of life." It added that "such direct military participation in the control of peacetime civilian activities is contrary to fundamental Amercan tradition."

"It is unfortunate," the statement continues, "that the House Committee, on its own initiative, has seen fit to discard the careful balance of military and civilian participation worked out so laboriously by the full Senate committee and approved by all the public officials directly responsible for the nation's military defense and security."

* * *

At a meeting held in Chicago on June 21, and attended by 300 members of the American Physical Society, the following resolution was passed.

For the well-being of the American people and in the interests of national security and for the good of American science, the McMahon Bill (S.1717) as passed by the Senate is a desirable piece of legislation. It is vital that this Bill be passed by the House without crippling amendments. We must not violate the tradition of the country by placing the military in a policy-determining position. Adequate military representation is furnished by the military advisory board provided by S.1717 as passed by the Senate. Complete civilian control of atomic energy must be secured.

Resolutions Passed by Federation of American Scientists

For the maximum progress toward world control of atomic energy, it is vital that the McMahon Bill (S.1717) be passed by the House without delay. The House Military Affairs Committee has proposed amendments which seriously jeopardize the objectives of the Bill as passed by the Senate. Overwhelming public and official approval including that of the President and of the War and Navy Departments, has been given to the principle of completely civilian control of this important policy-making function. The need for legislation on atomic energy control is pressing, and it is urgent that the McMahon Bill be enacted into law at once.

* * *

The Federation of American Scientists is following with great interest the negotiations in the United Nations Atomic Energy Commission. We do not regard the initial statements of position by the United States, the USSR, and the other nations as representing final crystallization of policy nor that all of the issues are by any means clear as yet. There is general agreement of all the negotiating nations on the goals of obtaining (1) security for the whole world against the surprise use of atomic weapons and (2) the development of scientific and industrial uses of atomic energy. We are definitely hopeful that the United Nations Atomic Energy Commission will find techniques for achieving these ends through continued study of the problem. As scientists we are conivnced that control of atomic energy by an international agency is technically feasible.

* * *

International cooperation and free exchange of ideas among scientists all over the world have been essential to full realization of scientific benefits to mankind.

The Federation of American Scientists is concerned about the present status of the liaison between scientists in the United States and those in other countries. The only existing official channel for such liaison is, by default of civilian agencies, through U.S. armed forces sponsorship. Profitable international cooperation in science can be more effectively achieved by U.S. participation in UNESCO, by passage of a National Science Foundation Act, by increased appropriations for scientific liaison to the Division of Cultural Relations of the State Department.

THE AMERICAN AND RUSSIAN PROPOSALS

(Continued from Page 1)

information, should not astound anyone. Neither of the two proposals touches upon the most fundamental issues. As pointed out by Walter Lippman, the insistence on prohibition of atomic bombs and destruction of existing bombs, is a sign of insufficient understanding of what the real danger is. There is no question that the existence of assembled atomic bombs constitutes a serious problem, but the true, long-range threat of atomic energy lies in uncontrolled large scale production of atomic explosives ("fissionable materials"), whether for military or for peace-time applications (atomic power). The importance of "atomic bomb secrets" also has always been (and still is) exaggerated by those with insufficient understanding of the real problem. The essential handicap of the Russians in the atomic arms race lies not in information which we are withholding from them, but in our possession of know-how, production and research facilities, and of trained personnel—advantages which no exchange of printed information can destroy.

* * *

It is important to stress that the Russian proposal did not *reject* the plan for international control and inspection of atomic energy proposed by Baruch; it merely took no stand on it. The Russian statement admitted that the outlawing of bomb production will have to be supported by an effective "supervision"—and so far, in America or England, whoever has attempted to think about what effective supervision means, has ended with some plan akin to the Lilienthal-Acheson Atomic Development Authority. The Russians have preferred not to commit themselves on this crucial point at the present time; Gromyko merely suggested the creation of a Committee to study the problems of control, supervision, and enforcement—while implying that the outlawing of the bomb and the release of information need not wait for this Committee to arrive at their conclusions.

It is to be hoped that as the Russian delegation finds time and opportunity to become steeped in the really fundamental problems of atomic energy, it will share the experience of the groups which have studied the possible mechanisms of international control in the United States and Britain, with the consequent expansion of the area of common understanding.

* * *

It is not only the Russians, who have yet to realize that the future of their nation, as well as that of the world as a whole, depends on world-wide control of atomic energy in all its aspects, and that the existence of a certain number of assembled atomic bombs and the possession of a certain knowledge of the methods of their fabrication are but temporary and relatively minor aspects of this grave problem. The same lack of understanding is quite common in this country, as the reaction of a part of public opinion to the proposals of Baruch and Gromyko shows. Too many still think that our physical possession of bombs and "bomb secrets" gives us a long-range security, and that our offers to "share" atomic energy benefits with other nations are a matter of pure selflessness. Far from it. Uncontrolled development of atomic energy by sovereign nations constitutes as terrible a danger to us as it does to all the other nations. As a free democratically governed nation with highly concentrated wealth and industrial power, we represent one of the most vulnerable targets of atomic warfare. Our interest in avoiding the possibility of such a warfare is so compelling, that we cannot afford to become angry or impatient, if other nations do not agree immediately with what we consider as a generous and equitable plan proposed in good faith. The establishment of an Atomic Energy Authority of the kind contemplated in the Baruch proposal is for us a matter of enlightened self-interest; we must bend all efforts towards persuading the USSR that it is equally a matter of enlightened self-interest for the Russians.

Material in this Bulletin is released for publication at 12 noon, Wed., July 3.

* * *

The present issue constitutes a double number—Volume 2, Nos. 1 and 2.

Availability of Radioactive Isotopes

(Continued from Page 22)

tion by a short letter to the Iso
Branch, Research Division, Manh
District, P. O. Box E, Oak Ridge, Te
see. This letter should request ap
tion forms, price quotations, and an
sential information not contained i
notice. It should indicate briefly the
isotopes desired, the approximate q
ties needed, and the use to be ma
the materials. If the desired materi
be produced or made available an
intended use is one for which the i
is suited, application forms will b
nished the applicant. These form
permit applicants to supply in a c
and uniform manner the necessar
tailed information on the basis of
the reviewers and the nonproject Ad
Subcommittee on Allocation and Di
tion will be able to recommend acti

Action on an initial formal appl
cannot be initiated unless it has be
dicated on the application that,
material is allotted, an "Agreeme
Order and Receipt of Radioactiv
terials" will be negotiated by the bu
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with the ordering, receipt, appli
and disposal of radioactive materi
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of authorization for this in the ori
negotiated agreement. All correspo
concerning requests and all forms
be addressed to the Isotopes Bra
indicated above.

By unanimous decision, the sc
attending the empire conference or
by the Royal Society in London r
the "closed-door" rule.

Foreign scientists will be free to
as observers. Not only formal m
but also all demonstrations and i
discussions in Cambridge this week
Oxford the following week will be

The delegates have expressed
feelings that the situation shoul
have arisen and that a scientif
should have demonstrated the prin
free discussion from the start.

BULLETIN OF THE ATOMIC SCIENTISTS

EDITORS:

H. H. Goldsmith **E. Rabinowitch**

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LETIN of the
ATOMIC SCIENTISTS . . .

L. 2 AUGUST 1, 1946 Nos. 3 and 4

Victory and An Impending Crisis . . .

HE McMAHON BILL BECOMES LAW

On August 1, the McMahon Bill, battered in the House t restored to almost its former self in the Senate-House nference, was signed by President Truman and became the v of the land.

The fight for legislation which would give the government at measure of control and supervision of atomic energy which indispensable because of the tremendous implications of this rce for good or evil, and which would at the same time safe-ard that freedom of research and development necessary for gorous scientific progress, began in October 1945, when an ill-vised attempt was made to rush through Congress the so-called y-Johnson bill. This Bill was a framework within which the my could perpetuate the wartime set-up of the "Manhattan oject" and maintain for an indefinite time its tight grip on work in nuclear physics.

The months-long hearings before the McMahon Committee d many disappointing moments, but slowly produced the de-ed result. Gradually, imperceptibly, even the most stubborn d reluctant of the senators on this Committee appreciated the vel "facts and implications" of atomic energy, and during last week of the session they were defenders of reason and deration against conferees on the House side, who had not nefited from a six months course in physical and political mistics.

Thanks of the scientists go to Senator McMahon, the sponsor the bill and untiring fighter for the principle of full civilian trol of atomic energy. In the last stages of the controversy, satisfactory outcome was largely due to Senator Vanden-g, whose authority with his Republican colleagues permitted bill, authored by a Democrat, to be passed by unanimous sent of the Senate. When the initial empt of Sen. Vandenberg to effect a mpromise" between civilian and mili-y rule met with violent opposition, and s branded as a wedge to military dom-tion, he immediately responded to this icism by helping re-write the Mili-y Liaison Committee clause in a form ch satisfied the responsible Army lead-and, which, at the same time, left no bt that all policy decisions are to re-n in the hands of a civilian Atomic ergy Commission.

* * *

he vigorous support of the cause of lian control by American public opin-which found its expression in the ation of "Committees for Civilian Con-of Atomic Energy" in several cities gely contributed to the final passage of McMahon bill. The many distinguished and women who have devoted them-es to this cause, well deserve of erican science, liberty and security.

owever, this successful mobilization of erican opinion against Army rule in science, is cause not only for rejoicing but also for serious thought. To a large extent, this rallying has been possible only because the American public has not yet become as alarmed with the prospects of atomic war as the facts warrant. The public—liberal and conservative alike—was ready to support us because the apprehension of a possible atomic attack on our cities, had not not yet engulfed its traditional beliefs in civil liberties and human rights. Atomic bombing still appears to most Americans as a Wellsian fantasy, despite the magazine articles and radio plays which have depicted such attacks in many gruesome details.

It is easy to predict that the mass-psychological reaction to a growing feeling of danger and insecurity—a development which will be inevitable if the armaments race is permitted to gain momentum—will be the gradual muffling of the voices of the defenders of civil liberty and democratic freedoms, and a rising clamor for vigorous police action and military leadership of the country. Since economic planning, medical preparedness, biological research and many other fields of activity are as vital for survival in the next war, as are atomic bombs and rockets, all these fields are likely to be drawn into the sphere of narrow military supervision and all threads of international cooperation may be cut. If it is treason, punishable by death, to reveal the number of neutrons released in the fission of plutonium, there is logic in expecting that, in a few years, it will be considered treasonable to reveal a cure against botulism, or the blueprint for a new city development.

Does this mean that scientists should stop "frightening the people," and cease emphasizing the dangers to American security implied in an atomic armaments race? The answer is that we would not be scientists if we were to refuse to recognize, and to state the truth as we see it. As scientists, we cannot but put our faith in the general recognition of truth and consequent intelligent action.

IN THIS ISSUE

THE UN ATOMIC ENERGY COMMISSION IN DIFFICULTIES

The danger that all gains achieved with the passage of the McMahon bill may be rendered illusory by a general tide of militarism and nationalism, arising from an atomic armament race, is made particularly ominous by the apparent deadlock in the deliberations of the United Nations Atomic Energy Commission.

Some delegates—notably the French and the Dutch — attempted to postpone the discussion of the legal status of the proposed International Atomic Energy Authority and of its relation to the Security Council, particularly in the field of enforcement and sanctions, until an area of agreement on the desirable forms of international control was first established.

(Continued on last page)

The UN Atomic Energy Commission . . .

The deliberations of the UN Atomic Energy Commission up-to-date (August 1) can be divided into three stages—(1) a series of plenary sessions in which the chief representatives of all twelve member nations delivered more or less elaborate declarations; (2) a series of meetings of the so-called "Sub-Committee 1," later superseded by "Committee No. 2" which was essentially devoted to the discussion of the Baruch plan, particularly in its relation to the present UN structure; and (3) the most recent meetings of the "Committee No. 2," devoted to the discussion of the Soviet proposal.

FIRST STAGE—PLENARY SESSIONS

The first two meetings of the full Commission, highlighted by the speeches of Bernard Baruch (U.S.A.) and Mr. Gromyko (U.S.S.R.) took place on June 14 and 19 respectively and were reported in the last issue of the Bulletin. In the third full session, on June 25, the round of policy declarations was completed. The main speeches of this session were those of Mr. Parodi (France), Dr. Lange (Poland) and Dr. Evatt (Australia). Following are pertinent quotations from these speeches:

A. PARODI (FRANCE): "I would like to point out the extent to which France has participated in atomic research. There is in France a long tradition of scientific study on these questions; an ancient tradition because it originates from the first discovery relating to radioactivity; and a constant tradition since at the beginning of 1939 French scientists brought decisive contributions to the work which led to the conquest of atomic energy."

"As soon as victory permitted France to end her war effort, she has given to the work of her research scientists a new impulse and a new direction. She has established a commissariat for atomic energy, whose task it is to study, and apply industrially, procedures for the utilization of forces liberated by the disintegration of matter. The necessary legislation has been passed to give this organization an absolute monopoly in this field. A plan for prospecting and for using the resources of radio-active substances has been taken up throughout the whole of French territory. We are now achieving our first concrete progress in the technical field and, in particular, in the construction of experimental apparatus and the industrial treatment of radioactive minerals."

"Finally, the French Government is now organizing a great institution for research in nuclear physics, pure and applied, and the most eminent scientists of my country are collaborating in the institution. An essential characteristic marks these studies, these plans and these achievements. It is that they are all directed entirely towards peace, towards the works of peace, towards activities whose essential object is the good of humanity."

"I am authorized to say that the aims which the French Government has assigned to the research work of its scientists and of its technicians, are absolutely pacific. Our wish is that all nations of the world should do the same as early as possible, and for this purpose my country will eagerly submit to the rules which may be judged the best, as soon as these rules are adopted by the United Nations, to ensure throughout the world the control of atomic energy."

"Two plans coming from two nations which are at present the most powerful in the world have been submitted for our consideration."

"Let us consider with all the attention that they merit, the proposals which have been submitted to us. The first of these has been submitted in the name of the United States by Mr. Bernard Baruch. The great American Nation has a primary responsibility in the matter which we are studying, because it is the United States which first succeeded in freeing atomic energy and which has perfected the weapon, which is derived from this discovery, because she alone has used this weapon, and because, at the present time, she is the only country, as far as our information goes, which possesses this weapon. The American Government is fully aware of this responsibility, and I would thank the American Government in the name of the French Government for having taken account of this fact in the plan which it has laid before us."

"The French Delegation wishes to say that it considers this plan as the most generous and the most broadminded plan which could be proposed to the Commission at the beginning of its meetings by the country which is the only country capable, at the present time, of manufacturing the atomic weapon and the only country which is in possession of reserves of this weapon."

"We have, now that the Delegate of the Soviet Government has made his statement, another element of capital importance that we must take into account for the future ordering of our discussions. The plan presented in the name of his Government by Mr. Gromyko is, like the American plan, aimed at proposing the most appropriate means to spare humanity the ravages which a new conflict would cause through the employment of atomic arms."

"The means that are proposed as conceived by the Soviet Government are in **part different from those suggeste[d by] the American Government. But afte[r a] first examination, it would appear tha[t] those points on which the plans are [not] in perfect accordance, they are neve[rthe]less not irreconcilable.** The views w[hich] dictated both plans, the primary int[erest] which exists for both the powers [con]cerned as well as for other powers, that an agreement mutually and gene[rally] satisfactory, should be reached on [this] matter, and the many common p[oints] apparent or implicit, which characte[rize] the two groups of suggestions, giv[e] the hope that it will be possible to [bring] these two plans into harmony."

"The chief characteristic of the [prop]osition that the Soviet Declaration b[rings] us, is its legal character. Independ[ently] of the proposal as to methods of wo[rk, it] consists essentially of traditional [diplo]matic solutions, such as a draft int[erna]tional convention to forbid the em[ploy]ment of atomic arms. This indispen[sable] element of a general system for the [solu]tion of this great problem may be g[ener]ally accepted, since the President o[f the] American Delegation spoke in so [...] words of an adequate regulation of a[tomic] energy, including the renunciation o[f the] atomic bomb as a weapon.

"But like the American Delegatio[n, the] French Deleagtion considers that a [con]vention eliminating the atomic arm s[hould] include not only, as Mr. Gromyk[o] emphasized quite rightly, the char[acter]istic of a solemn engagement, but it s[hould] also be insured that its strict appli[cation] is absolutely guaranteed."

"In this entirely new field, in vi[ew of] the scope and the sudden character [of the] atomic bomb, not only no violation [...] possibility, no suspicion of violatio[n can] be tolerated. This means that the [...] of supervision and guarantee of o[bserv]ance are inseparable in the conv[ention] itself."

"The Soviet Plan provided exp[...] for this, and recommends that th[e or]ganization for supervision should [...] of the subjects to be studied by the [com]mittees whose establishment the [...] envisages. It appears, then, that [...] all in agreement upon a certain n[umber] of prinicples. The atomic bomb m[ust be] eliminated. The obligation whic[h] governments shall take upon oursel[ves for] this purpose, shall be applied under [super]vision. Effective sanctions shall be [...] to anyone violating these obligatio[ns. It] is as regards the relative importa[nce to] be attached to these various pri[nciples] and above all the order in which [their] application must be effected, that [diver]gencies of view appear between t[he] plans presented to us at the presen[t time.] These divergencies are certainly su[...]

a sincere desire to succeed should be capable of removing them."

"The nature of the problem itself imposes upon us the necessity of dealing with this subject and also the inequality which reigns today among the nations from the point of view of knowledge of the production and of the use of raw materials, energy, and atomic bombs. **We should run the risk of compromising the success of our work if we were to demand at the outset from any country that it should place before the public, at a sole stroke, the results of several years of prodigious, technical, and industrial effort without receiving in return guarantees involving the adoption of an effective system of international control. An equal risk would be run, were we to demand that other countries should themselves make the first step in placing their resources in raw materials under international control. It would be too much to demand this without supplying them with information as to the manner in which these materials should be treated. It is thus, through a wise arrangement of the steps into which our task is to be divided, that we shall find the solution of the problem confided to us."**

"Let us remember that the outlawry of the atomic bomb is only one of the elements of this highly important idea, this indivisible conception of security. Let us remember that the statesmen will not have carried out their duty toward the nations until they have assured complete security."

"Mr. President, the world needs light. Let us hasten to provide this light. Only at this price can we give humanity peace and salvation."

* * *

The speech of Mr. Parodi indicated the desire of the French delegation to find a compromise between the American and the Soviet proposals. The French made clear in this and subsequent declarations that they would not surrender the American principle of effective international control, but that they were inclined to meet the USSR in the matter of the veto and of the subordination of the Atomic Control Authority to the Security Council.

* * *

DR. LANGE (POLAND): "At the meeting of the General Assembly in London on January 24, 1946, the Vice Minister of Foreign Affairs of the Republic of Poland, Mr. Modzelewski, brought forward certain proposals:"

'As it is agreed that the United Nations must take measures to preserve the present and the future generations against the use of atomic energy and other scientific discoveries for mass destruction and as one of the most effective measures to this end can be taken through the parliaments of the States members, we suggest that the Assembly should recommend to the Delegations here that their parliaments should adopt laws embodying the following principles:

1. 'That States should exchange between each other all discoveries of a scientific character such as that of atomic energy.
2. 'That the results obtained in his scientific field should be used only for the benefits of humanity and not for its destruction.
3. **'That the member States should support the United Nations Organization in its efforts to control and supervise the use of atomic energy for peace.**
4. **'That members of the United Nations undertake to eliminate atomic arms and other arms for mass destruction from their national armaments.**

"I am very glad to find that the basic ideas of these proposals are contained in the statements made both by the representatives of the United States and of the Soviet Union, but the world needs quick action. The threat of atomic warfare is hanging over the peoples of the world like a heavy cloud. It poisons international relations and may even today be considered as seriously endangering the mutual confidence, and consequently also the peaceful relations among nations. The discovery of the atomic bomb has become a source of mistrust between nations, a source which must be removed as quickly as possible."

"We have been discussing he technical and economic problems concerning the production of fissionable material, of control of plants, of strategic distribution of raw material and plants. This is all important and interesting, but it is not the most important thing. **In order to restore confidence among nations the peoples of the world must know one thing. They must know that atomic bombs are no longer being produced.** The peoples of the world want to be reassured that what happened in Hiroshima and Nagasaki and what now is going to be demonstrated in Bikini will never be repeated at any place of the globe. Without this knowledge, without this reassurance there will be no confidence among nations, and in the long run, there will be no peace."

"In connection with this problem I should like to point out to you that we have had in recent history other kinds of weapons considered incompatible with the ethical ideas of our culture and civilization. Such weapons are gases and certain liquids. Their use for purposes of warfare has been eliminated by the Geneva Protocol of June 17, 1925, and the conscience of the civilized world felt so strongly about it that even in the last war, the most destructive of all, these weapons were not used. The successful record of the Geneva Protocol points the way toward the elimination of atomic energy as a means of warfare. Without prejudice to long range plans like that proposed by the United States, the representative of Poland wants to urge this Commission to adopt immediately measures leading to the outlawing of atomic warfare. The proposal of such measures has been laid before us by the representative of the Soviet Union."

"This representative has proposed a draft convention aiming at the immediate outlawing of the "production, storage and use of weapons based upon atomic energy" and also for the immediate destruction of all such weapons in whatever part of the world they may be. The draft convention proposed by him provides also for means of individual punishment for violators of this convention."

"In the name of the government of Poland, I want to give my full support to the draft convention proposed. It contains all the basic ideas which were brought forward in the name of our government by Mr. Modzelewski at the January meeting of the General Assembly."

"After the completion of this first step of our program—namely, the outlawing of atomic warfare and the destruction of the means of such warfare—we can proceed toward further steps. Such steps are: (a) the exchange of scientific information (b) the development of a system of international control and inspection which will secure the exclusive use of atomic energy for the aforesaid peaceful purposes. At this stage we also may consider the problem of **international sanctions which should gradually supplement the internal control and sanctions proposed by the Representative of the Soviet Union."**

"To those, however, who do believe that they can profit from the martial use of atomic energy for their own narrow and selfish purposes, I should like to direct one word of warning. There was a group of people who thought that they could dominate the world through the ruthless use of the most advanced means of destruction, of which they had a temporary monopoly. They thought that by quick lightning warfare they could achieve their ends. . . Today Adolf Hitler is dead but Poland is very much alive. Others are being tried at Nuremburg. No temporary advantage, by whomever held, will prevail against the will of the people to preserve their freedom and against the conscience of mankind."

* * *

Mr. Lange seconded the Russian proposal as a first step, but was more explicit than Mr. Gromyko in acknowledging the necessity of effective international control and international sanctions against violators as a second step. Whether un-

knowingly or prompted by political considerations, he adopted Gromyko's unrealistic attitude in overestimating the importance of "making atomic bombs" and ignoring the fact that the production of fissionable materials, *whether for war or peace, is the crux of the matter.*

* * *

Dr. VAN KLEFFENS (THE NETHERLANDS): "Two plans which fortunately seem by no means incompatible have been laid before us: the American plan, bold, realistic, and imaginative, has as yet only been presented in outline; Russian ideas, following more traditional lines and with a different emphasis, have been presented with somewhat greater precision. The Netherlands Government is studying both plans with all the attention and sympathy they both deserve."

"I am sure, however, that we should begin working on a specific draft as soon as possible. If we continue too long with a general discussion, indispensable as, no doubt, this is, I fear that avoidable misunderstandings may easily arise, or we might find ourselves talking at cross-purposes with no benefit for anybody, and least of all to the attainment of our high purposes."

"I think any committee to be established should in the first instance limit itself chiefly, if not entirely, to the positive and constructive side of the question. What I mean is this; **if we start discussions now, right at the beginning, on questions of veto or of penalization, we might get into very serious difficulties for which there is perhaps no need.** It seems to me that these questions should be taken up afterwards, that is, once we are much clearer in our minds as to the sort of plan we wish to see carried into effect. I am convinced that these thorny subjects would then be much easier to deal with—difficult as, of course, they must remain, than at the present stage of our labors.

* * *

DR. EVATT (AUSTRALIA): "In our view, the highly complex problem which confronts us must be considered as a whole. From this point of view, the plan submitted by Mr. Baruch offers a sound basis for planning. The Australian Government is in general agreement with the proposal of Mr. Baruch that, as part of a single plan, an international authority be established, for the purpose of preventing the misuse of atomic energy and ensuring its use for the purpose of promoting the general welfare of mankind."

"Mr. Gromyko has suggested the study of a draft international agreement forbidding the manufacture and use of atomic weapons, to be followed by other measures involving strict supervision and control to see that the terms of the agreements are strictly observed. **Mr. Gromyko's proposals, however, do not, in my view, give sufficient recognition to the essential interrelation between all the various parts of the one great problem."**

"It was with a conviction of the urgency of this single problem that the Assembly instructed this Commission to proceed, 'with the utmost despatch'. Now, this urgency is based on both negative and positive reasons. Negatively, atomic energy is such a danger to humanity that it must be lessened and then removed. Positively, atomic energy can be such a boon to humanity that we must not delay in releasing its beneficial forces."

"If there is long delay in solving the international aspects of the problem, scientists in one country or another may discover new and revolutionary processes for the release of atomic energy."

"Delay may also lead nations to build stockpiles of fissionable materials for atomic bombs with the result that required material will not be available for the production and use of atomic energy for industrial and scientific purposes."

"Long delay may even endanger the United Nations Organization itself, for delay may arouse the suspicion of the peoples of the world that the powers will produce atomic weapons because they are incompetent to agree upon a means for just and equitable control."

"It is inevitable that in the first instance any nation will be inclined to approach the problem of atomic energy from the point of view of its own security and welfare. World security and world welfare cannot be successfully promoted if we fail to recognize this tendency. Each nation will wish to avoid the use against itself of the devastating weapons which the release of atomic energy makes possible. Each nation will seek to enjoy as soon as possible the benefits which atomic energy can bring, in scientific development, in the art of medicine and as a source of industrial power."

"It is to be expected that countries which are relatively poor in existing power resources, and particularly those countries which also possess significant deposits of uranium ores and thorium concentrates, should be concerned with the possibility of rapid application of nuclear energy for the production of industrial power. There are nations whose industries may decline in the absence of an alternative to coal as a source of power, and to such countries even the terrors of atomic warfare may often appear more remote than a dwindling economy or decreasing standards of living. There are other countries where supplies of power not involving the transport of **large quantities of coal or the buildin[g] of long electrical transmission lines woul[d] open upon new areas of agricultural o[r] mineral development. Abundant power a[t] reasonable cost is the lifeblood of moder[n] industry. Power from atomic energy ma[y] enable modern communities to flourish i[n] regions remote from existing sources o[f] power. Such nations, for whom the peace[-] ful uses of atomic energy are of mor[e] immediate importance will be likely to de[-] mand access at the earliest possibl[e] moment to such materials and informa[-] tion as may be necessary for them to de[-] velop atomic energy for peaceful pur[-] poses."**

"These considerations should all b[e] borne in mind when the timetable fo[r] the World Development Authority, th[e] exchange of information and the imposi[-] tion of controls and sanctions are bein[g] discussed and planned."

"I have already mentioned the specia[l] interest of those countries which posses[s] within their territories deposits of urani[-] um and thorium and who are thus able t[o] make an important contribution as sup[-] pliers of raw materials. One should no[t] be surprised if some such countries ar[e] reluctant to accept control of their prod[-] uct by any international authority unles[s] controls are also accepted by those coun[-] tries possessing plants for the productio[n] of fissionable materials. Therefore, whil[e] control of mining operations and of the ra[w] materials extracted from the ores ma[y] well form an essential basis of internation[-] al control system, that system will als[o] have to provide for disclosure of scientif[ic] and technical information and for th[e] cessation of production of atomic weap[-] ons, on terms and conditions to be agree[d] upon and defined. All this illustrates th[e] necessity of an international agreemen[t] which will, in the one instrument, defin[e] the obligations to be accepted by th[e] parties to the instrument and establis[h] an atomic energy authority through whic[h] those obligations can be made effective[."]

"The Australian Government agrees [to] establishment of an international autho[r-] ity to act as the organ of the Unit[ed] Nations in the field of atomic energy. Th[e] exact relation of such an authority wi[th] the United Nations will require detail[ed] consideration. One question of this cha[r-] acter which was referred to by Mr. Baru[ch] is the application of the so-called veto. [It] is essential that the precise nature of th[is] special privilege should be clearly unde[r-] stood."

"At present, the veto power relat[es] solely to a particular method of voti[ng] in reaching decisions of the Security Cou[n-] cil on matters of substance as distin[ct] from procedure. If any one of the fi[ve] permanent members of the Securi[ty] Council chooses to do so it can block

cision of the agreed majority (7) of e Council membership of eleven. Thus e so-caled "veto" can be only exercised the course of voting in the body of the curity Council by a permanent member order to prevent a vote by seven mem-rs of the Council from becoming effec-e. It is quite erroneous to apply the rm "right of veto" to decisions of the nited Nations generally because it is ly in relation to one of its organs that e right has been conferred. That right plies solely to the special circumstances the operations of the Security Council d the possession of such a right in the uncil does not give any claim to a similar to in respect of the operation of any her international authority.'

'To some extent the recommendations this Commission wil require review the Security Council. In such review the o may be exercisable according to the cumstances, that is to say, whether the tter is one of procedure or substance. this Commission of twelve, no veto is rcisable unless we decide to introduce which, so far as I know, is not even templated. When the Assembly of the ited Nations deals with the welfare ects of atomic energy, again no veto exercisable. If in the end an internation- convention establishes a world atomic hority, the day-to-day administrative isions of that body may or may not subject to the veto system of voting. t is a matter for the consideration this Commission when it is reviewing problem as a whole."

However, I think I should add that, in view, nothing has been disclosed re-ding the nature of atomic energy or he posssible functions of the proposed rnational authority on atomic energy ndicate why any particular nation or ons should be accorded the right of over the decisions of the agreed ority of the Authority."

t would appear that one immedicte before us is to consider the drawing of a first draft, of the heads of an rnational instrument. I believe that n the statements which have been made re this Commission it is possible for orking committee, composed of repre-atives of each of the members of this mission to prepare a fi--t draft of main principles of a charter for a d authority to control and develop nic energy. The Committee would of se have before it not only Mr. Baruch's ement in opening, but also the obser-ons, criticisms and suggestions which been made by the other eleven mem- of the Commission."

he people of the world are following proceedings of this Commission with t anxiety and concern. They are look-o us for prompt action. They will not be satisfied with expressions of mere hopes and aspirations. They are demanding a plan which will at once remove a great fear from their hearts and bring them closer to the benefits that scientists and technicians of this age can and will make available from the bountiful forces of nature."

Mr. Evatt's arguments largely coincide with the attitude presented in the editorial in the July 1 issue of the Bulletin; he, too stresses that the essential aspect of the veto problem in relation to the control of atomic energy is that no veto power shall hamper the day-to-day operations of the proposed international authority. Questions of major violations and sanctions belong to the jurisdiction of the Security Council, in which the veto power for questions of substance is provided by the present UN constitution and cannot be abolished exclusively for the discussion of conflicts arising from applications of atomic energy.

After the course of speeches was com peted with the declaration of Mr. Evatt, the American delegation prepared a chart listing 20 points raised by Baruch's declaration, and classified the attitudes of the twelve member nations to these proposals. Essentially, the "Baruch Chart" showed agreement of the majority of the nations to most American proposals, with the following important exceptions:

USSR: "No" to abolition of veto and to "any effort to undermine the Security Council".

"Perhaps later after discussions in a sub-committee to be set up"—to all proposals of control and inspections.

Poland: "Eventually" to all control and inspection proposals.

To this it must be added that **France** and **Holland** advocated postponement of arguments about veto and sanctions, and urged the discussion of the control scheme first.

After July 1, the commission as a whole met only twice in brief sessions— on July 3 to approve the Rules of Procedure and on July 18 to elect a new Chairman. The Rules of Procedure were then unanimously adopted, sent to, and confirmed by the Security Council.

The new chairman of the Commission, elected to replace Mr. Evatt of Australia, who was leaving for Paris, is Capt. Silva of Brazil (the chairmanship being rotated in the alphabetical order of the countries represented).

On June 28, a Working Committee of the full committee was established which included one delegate from each of the twelve nations.

SECOND STAGE–COMMITTEE DISCUSSION OF AMERICAN PROPOSALS

Baruch's summary chart, referred to above, provided the starting point for the deliberations of the "Sub-Committee 1" established by the Working Comittee of the whole Commission on June 28 and consisting of the representatives of France, Mexico, Great Britain, United States, USSR, and Australia. The terms of reference of this Sub-Committee were "to study all proposals put forward and to prepare the framework of a possible plan by presenting to the Working Committee a list of headings of topics to be considered."

Although Mr. Gromyko insisted that the terms of reference should refer to **all** proposals and not only to the Baruch plan, it seems that the discussion in the Sub-Committee dealt mainly with the American concept of an Atomic Development Authority and immediately concentrated on the very problems—the relation of the ADA to the Security Council and its discretionary powers—that the French and Dutch delegates wished to postpone in order to avoid "unnecessary disagreements."

No complete transcripts of the Committee meetings have been published; the following report is based mainly on the memoranda presented by the individual members.

* * *

Sub-Committee 1 began its work on July 1 with an outline of six topics to be discussed, presented by its chairman, Dr. Evatt.

TENTATIVE PROPOSALS BY CHAIRMAN OF THE ATOMIC ENERGY COMMISSION—DR. H. V. EVATT (AUSTRALIA)

In order to explore the possibility of making recommendations covering all the main aspects of the problem as discussed in the Commission, the following general principles should be examined:

1. There should be a single international instrument embodying (a) a comprehensive plan for the international control and development of atomic energy; (b) the establishment of an international atomic energy authority to administer and carry out the plan and to be vested with wide discretionary powers; (c) that, as part of the plan, there should be undertakings by member nations not to use atomic energy for purposes of war; and (d) that the several parts of the plan shall come into effective operation under terms and conditions which are just and equitable, having regard to the over-riding purposes of the plan.

2. That, for the purposes of carrying out the plan, the international authority should be vested with all necessary rights in the relevant raw materials, processes, plants and the products of plants.

3. That an effective system should be established for preventing breaches of the agreed restrictions and controls.

4. That the international authority shall be required to promote and carry out plans for the development of atomic energy for peaceful purposes.

5. That scientific information on nuclear processes and their application to peaceful purposes should be exchanged, care being taken at each stage not to prejudice the effectiveness of the agreed safeguards against misuse. Such exchange of information should take place by interchange of personnel and through open publication.

6. That the general plan should provide that, at times and under conditions to be fixed by the international authority, the manufacture of atomic bombs should cease and all existing bombs should be dismantled.

* * *

Also on July 1, the following "Point of View" was presented by Prof. Joliot-Curie on behalf of the French delegation. The emphasis is on the subordination of the ADA to the Security Council—a concession to the Russian desire to leave the power of the Council unimpaired.

(2) POINT OF VIEW OF THE FRENCH

1. CONVENTION AND CONTROL.

(a) The ideas of supervision and guarantees are inseparable from the Convention.

(b) The Convention would become effective at the stages and in the manner provided by the Treaty.

2. AUTHORITY OF CONTROL.

(a) There should exist a special international controlling Authority to be established by the General Assembly.

(b) The Authority should report to the Security Council on its controlling and administrative activities and should notify the Council of all breaches of rules which it would have been able to detect.

(c) The Authority should be the necessary technical Counsel to the Security Council. The Security Council should refer to the Authority, for advice, all questions placed before it, on matters bearing on development or control of atomic energy.

(d) The Security Council should be the only authority responsible for decision taken in the interest of peace and for the security of the United Nations.

* * *

On July 2 and July 5 two memoranda were submitted to the Sub-Committee by Mr. Eberstadt on behalf of the U. S. delegation. The first consisted of an outline of a treaty embodying the establishment of the ADA, provisions for the enforcement and punishment of violations, and several additional topics. Following are the salient points of this memorandum:

(3) EXCERPTS FROM MEMORANDUM NO. 1 SUBMITTED BY THE U. S.

The **preamble** of the treaty should express the following principles:

1. The preservation of international peace and security in accordance with the Preamble and Chapter I of the Charter of the United Nations;

2. The safeguarding of all peoples against the use of atomic weapons;

3. The development and wide distribution of atomic energy and its by-products for purposes of raising the welfare and standard of life of the peoples of the world and of contributing to their science and culture; and

4. The realization of these ends through international co-operation, through an international agency, for the development and control of atomic energy, and through a system of international enforcement.

The treaty should contain provisions:

1. Defining the relations between the Authority and the Security Council, the General Assembly, the International Court of Justice, and the other organs of the United Nations;

2. Defining the mutual rights and obligations of the several signatory States and the Authority, including the relations between the Authority and any atomic energy control agencies of the signatory States;

3. Governing the sequence and timing of the steps in the transition from the present conditions to the conditions which will prevail once the Authority is in effective control of atomic energy;

4. Specifying the time when and the conditions under which the national and private possession, manufacture, and use of atomic weapons shall be outlawed;

5. Defining the violations which shall constitute international crimes and specifying the sanctions to be employed for such violations;

6. Relating the signature, ratification, entry into force and amendment of the treaty; and

7. Concerning any necessary amendment of the charter of the United Nations.

The charter of the Atomic Development Authority should state the following purposes of the Authority:

1.To prevent the possession, manufacture or use of atomic weapons for mass destruction;

2. To foster the beneficial, non-dangerous uses of atomic energy;

3. To have managerial control or ownership of all atomic energy activities potentially dangerous to world security;

4. To control, inspect, and license all other atomic energy activities;

5. To engage in atomic energy researc[h] and development; and

6. To assure that the benefits derive[d] from such research and development sha[ll] be available to the peoples of all th[e] signatory States so long as each Stat[e] and its people support the Authority an[d] observe their obligations under the treat[y] and charter.

The memorandum proceeds to enumer[-]ate the powers of the proposed Authorit[y] following closely the suggestions of th[e] Acheson-Lilienthal report (see **Bulleti[n]** V. 1 No. 8, and the article by **J. R. Oppe[n]heimer** in V. 1 No. 12.).

Provisions for enforcement should b[e] included in the treaty as follows:

1. Definitions of conduct constitutin[g] violations.

2. Consequences of such violations, i[n]cluding the procedures to be followed i[n] detecting, establishing, remedying [or] punishing such violations:

(a) Administrative action by the Aut[h]ority.

(1) Special investigations.

(2) Revocation or denial of lice[n]ses.

(3) Other action.

(b) Resort to judicial processes a[nd] procedures.

(c) Reference of serious violations [to] the Security Council of the United N[a]tions.

Among the **additional topics** to be pr[o]vided for in the treaty are:

Legal capacity and privileges and i[m]munities of the Authority in the territo[ry] of each signatory State.

Privileges and immunities of offici[als] of the Authority.

Financial provisions, and

Measures to insure adequate protecti[on] and strategic location of the premises a[nd] property of the Authority.

Consideration of the charter first wo[uld] afford an understanding of the functi[ons] to be performed by the Authority a[nd] would facilitate agreement upon [the] other provisions of the treaty.

* * *

The second American memorand[um] contained an even more detailed descr[ip]tion of the powers and functions of [the] Atomic Development Authority. H[ere] again, the proposals of the Acheson-L[i]lienthal report were followed. One m[ay] say that with the presentation of t[his] memorandum, the Acheson-Lilient[hal] ADA-scheme, for the first time, was a[ck]nowledged as the official American p[lan] of dealing with atomic energy proble[ms] (since the original Baruch speech [was] restricted to the enunciation of gen[eral] principles). Because of the length of [the] memorandum and its close similarity [to] the Acheson-Lilienthal report, we will [not] attempt to print its content here, but

ely quote some of the final para-phs, which touch upon the topic not sidered in the Acheson-Lilienthal re-t—the relation of the ADA to the O.

EXCERPTS FROM MEMORANDUM . 2 SUBMITTED BY THE U. S.

art 7. The exercise by the Authority he controls referred to above will call a wide variety of administrative de-ons based upon fair, sound and respon-e judgments. In suggesting the con-ing of these powers upon the Author-it is not intended that their exercise the Authority should be absolute, un-ted and free from review. Obviously, o certain specific fields and functions e defined in the treaty, the Authori-decisions would be final. In others would not. It is our intention in ing with the relation of the Authority ther elements of the United Nations reat this phase of the subject more y, and also to present proposals for rcement of the provisions of the aty and Charter as well as for sanc-s for violations.

art 8. As a function of its control rations, the Authority should make vision for the rendering of frequent detailed reports to the appropriate ans of the United Nations and to the stituent nations, embodying the re-s of its researches, new discoveries in atomic field, the level of its material kpiles, new locations of ores and all r important and pertinent informa-.

addition, properly accredited repre-atives of the United Nations and of constituent nations should be per-ed, under suitable regulations, to in-t the plants, properties, records and rations of the Authority.

* * *

s mentioned above, the relation of the A to the other UN organs had become main subject of controversy in the mittee. The following memorandum t with this subject.

EXCERPTS FROM MEMORANDUM 3 SUBMITTED BY THE U. S.

e nature of the relations of the Atomic elopment Authority with the various ns of the United Nations obviously depend upon the powers and functions h the Authority receives and upon its utes within the framework of the ed Nations. Once these are made clear, problems involved in the adjustment of Authority to the organizational struc-of the United Nations become clear can be solved.

ree general considerations appear at outset.

1. The first arises from the fact that the question of control and development of atomic energy was neither considered nor dealt with in the framing of the Charter of the United Nations. This circumstance, however, should not be permitted to prevent bringing within the framework of their charter a matter of such vital common concern to the members of the United Nations. On the contrary, if the Charter is to survive, it must be susceptible of adaptation to meet new needs dictated new conditions. The control and development of atomic energy, therefore, should not lead to the formation of an international agency unrelated to, or outside of, the United Nations, but rather to one fashioned in sound relationship to the Charter and to the organs thereby created.

2. Secondly, none of the existing organs of the United Nations possesses the managerial, proprietary, inspecting, and licensing powers necessary to effective international control and development of atomic energy. A new agency therefore is neccessary. Moreover, even if the Charter could be construed to provide for a subsidiary organ created by collective action of several of the existing organs and possessing an aggregate of power delegated by each of them, such subsidiary organ would not have adequate powers under the Charter. Accordingly, the Authority, as a new organ, should be established by treaty granting it all necessary powers and defining its relation with the existing organs of the United Nations.

3. The third general consideration concerns the degree of autonomy of the Authority. Having in mind the essentially non-political character of the Authority, the presumably high caliber of its personnel, and the necessity for wide discretion on its part in order to achieve its purposes of control and development, great weight and a considerable degree of finality should be given to its determinations, orders and practices. Where their consideration is required by another organ, they should be accepted unless clearly erroneous or beyond the scope of the Authority's powers.

Three categories of decisions may be mentioned. They will, of course, need careful definition. In general they are (1) Administrative matters on which the decisions of the Authority are final; (2) Decisions on other matters not of sufficient gravity to constitute a threat to the peace. These might be subject to review, possibly by a board established for this purpose. Its decisions, in turn, should be enforced by the Security Council as procedural matters, for, regardless of the original seriousness of the offense, failure to respond to the proper orders of the Authority creates a situation demanding the attention of the Security Council. (3) Serious offenses constituting a threat to the peace. These, as hereinafter outlined, fall within the jurisdiction of the Security Council and the provision of Article 51 of the Charter.

One further comment is in order before taking up in detail the relation of the Authority to the organs of the United Nations. Article 2, paragraph 7 of the Charter will not be infringed by the Authority. This paragraph is confined to matters "esssentially within the domestic jurisdiction of any state". Specific recognition in the treaty that control of atomic energy cannot be essentially domestic but rather predominantly international would be sufficient to render this paragraph inapplicable.

The respective functions of the Authority and of the organs of the United Nations, when viewed in the light of the foregoing considerations, indicate the general relationships which should prevail. They are outlined in the following paragraphs.

(a) **The General Assembly.**

The General Assembly is composed of all members of the United Nations. Its Composition, Functions and Powers, Voting and Procedure are contained in Chapter IV, Articles 9-22 of the Charter of the United Nations. Provisions with respect to the General Assembly also appear in other parts of the Charter. The character of the General Assembly and its importance in the whole concept of the Charter indicate, amongst others, the following respects in which the Authority may properly be related to it.

(i) The Authority should submit periodic and, when necessary, special reports to the Assembly concerning the Authority's activities, programmes, and information.

(ii) The provisions for discussion and recommendation by the Assembly contained in the Charter should be construed to include matters pertaining to the Authority.

(iii) The Assembly also might appropriately have a role in connection with the budget of the Authority.

(b) **The Security Council.**

The Charter of the United Nations confers on the Security Council primary responsibility for the maintenance of international peace and security. (Chapters V, VI, VII, VIII, and XII). Many of the important features of the control and development of atomic energy, though by no means all of them, are intimately associated with the maintenance of international peace and security. With respect to these features, the Authority and the Security Council must

be brought into close relationship.

The following particulars in this regard are suggested:

(i) In the event of an occurrence within the area of the Authority's jurisdiction constituting a threat to the peace, breach of the peace or act of aggression, such occurrence should immediately be certified by the Authority to the Security Council, the Assembly, and the signatory states. The treaty should establish this category of offenses and the conditions surrounding them. For purpose of illustration, they might include violations such as those specifically mentioned by Mr. Baruch in the United States proposal, viz:

"(a) Illegal possession or use of an atomic bomb;

"(b) Illegal possession, or separation, of atomic material suitable for use in an atomic bomb;

"(c) Seizure of any plant or other property belonging to, or licensed by, the Authority;

"(d) Willful interference with the activities of the Authority;

"(e) Creation or operation of dangerous projects in a manner contrary to, or in the absence of, a license granted by the Authority."

The controls established by the treaty would be wholly ineffectual if, in any such situations, to be defined in the treaty, the enforcement of security provisions could be prevented by the vote of a state which has signed the treaty. Any other conception would render the whole principle of veto ridiculous. It is intended to be an instrument for the protection of nations, not a shield behind which deception and criminal acts can be performed with impunity. This in no way impairs the doctrine of unanimity. No state need be an unwilling party to the treaty. But every state which freely and willingly becomes a party to the treaty, by this act, solemnly and firmly binds itself to abide by its undertakings. Such undertakings would become illusory, if the guarantee against their breach resided solely in the conscience of the one who commits the breach.

All parties to the treaty and all peoples of the world, must have protection of a final and dependable character against the terrible consequences of the destructive use of atomic energy. Such protection requires international machinery which can and will function quickly — machinery which does not permit the offender to be protected by his own or another's negation of the exercise of joint power essential to the security of all. Particularly is this true, with respect to matters which become essentially procedural once the Authority has made its certification based on the substantive provision of law established by the treaty.

The relation of the Authority to the Security Council should recognize this principle. Subject to this principle, the Security Council should have full jurisdiction over serious violations certified to it by the Authority. This is no manner impairs or diminishes the power or the modus operandi of the Security Council in any other situation.

As the United States Representative on the Atomic Energy Commission stated at the opening session:

"I want to make very plain that I am concerned here with the veto power only at it affects this particular problem. There must be no veto to protect those who violate their solemn agreements not to develop or use atomic energy for destructive purposes."

Voluntary relinquishment of the veto on questions relating to a specific weapon previously outlawed by unanimous agreement because of its uniquely destructive character, in no wise involves any compromise of the principle of unanimity of action as applied to general problems or to particular situations not forseeable and therefore not susceptible of advance unanimous agreement.

What has been said above must be emphasized. It is not intended to limit the powers, authority, responsibility or jurisdiction of the Security Council to maintain international peace and security. It is quite possible that in a major case of aggression, violation of the atomic treaty and the rules of the Authority may play an incidental part. Nothing herein suggested is intended to restrict or limit the over-riding powers of the Security Council to deal with such matters unaffected by the incidental inclusion of atomic energy considerations as part of the problems.

(ii) It is impossible to treat this subject without reference to Article 51 of the Charter, which provides as follows:

"Nothing in the present Charter shall impair the inherent right of individual or collective self-defense if an armed attack occurs against a Member of the United Nations, until the Security Council has taken the measures necessary to maintain international peace and security. Measures taken by members in the exercise of this right of self-defense shall be immediately reported to the Security Council."

Interpreting its provisions with respect to atomic energy matters, it is clear that if atomic weapons were employed as part of an "armed attack," the rights reserved by the nations to themselves under Article 51 would be applicable. It is equally clear that an "armed attack" is now something entirely different from what it was prior to the discovery of atomic weapons. It would therefore seem to be both importa and appropriate under present conditio that the treaty define "armed attack" a manner appropriate to atomic weapo and include in the definition not simp the actual dropping of an atomic bon but also certain steps in themselves p liminary to such action.

(iii) The Authority may be required carry out certain decisions by the S curity Council with respect to wh the assistance of the Authority is deem appropriate.

(iv) Reports and other informati should be submitted by the Authority the Council concerning the Authorit activities, programmes, and informati particularly as they bear upon maintenance of international peace a security.

(v) Consultation by the Military St Committee with the Authority on qu tions relating to the military reperc sions of the Authority's plans, or actio should be provided for in the treaty

The foregoing indicates the manner which appropriate relations between Authority and the United States might established in accordance with the prin ples stated by Mr. Baruch in the Unit States proposal.

* * *

The activity of Sub-Committee 1 en on July 12, before it had time to consi the U.S. memorandum No. 3. Dr. Ev summarized the Sub-Committee's delibe tions in the following report to the Wo ing Committee of the whole commissi

GENERAL REPORT OF SUB-COMMITTEE NO. 1

DR. H. V. EVATT

1. Pursuant to authority conferred u me as Chairman of the Working Co mittee of the Atomic Energy Commiss at a meeting held on June 28, 1946 appointed to membership of Sub-Co mittee No. 1 the representatives of Fra Mexico, the United Kingdom, the Uni States, and the U.S.S.R., together w the Chairman of the Atomic Energy Co mission.

TERMS OF REFERENCE

2. The duties of Sub-Committee No were broadly to consider the princi and proposals presented to the Ato Energy Commission and ascertain area of actual or prospective agreem having in view the ultimate preparat of a framework of an international inst ment for the control and development atomic energy to secure its use for pea ful purposes only.

3. The Sub-Committee held five meeti on July 1, 2, 5, 8 and 11 respectively. every meeting the entire membership present. After the first two meeting directed that every country not alre represented on the Sub-Committee co be represented by an observer if so desi Advantage was taken of this directio

At its five meetings Sub-Committee 1 considered the main principles of various proposals presented to the mic Energy Commission and the Sub-mmittee itself. Full opportunity was rded to all members to present views additional proposals and to ask stions of others in the interest of clari-tion. There was a frank exchange of vs, the value of which should become dent as the task of the Commission arried forward.

RKING DOCUMENTS

As an aid to its discussion, the Sub-mmittee had before it six documents pared by the United States, Australian French delegations, as follows.

a) Chart prepared by the United States Representative showing the attitude of delegations on specified topics and proposals made to the Atomic Energy Commission (This chart has been amended by delegations in several respects).

b) Tentative Proposals by the Chairman of the Atomic Energy Commission, Dr. Herbert V. Evatt (Australia), submitted July 1. (Suggesting the examination of certain general principles of a multilateral treaty on atomic energy).

c) Document containing the point of view of the French Delegation on questions of principle discussed in the first meeting of Sub-Committee No. 1, submitted July 2.

d) Memorandum submitted by Mr. Ferdinand Eberstadt on behalf of the United States Delegation, submitted July 2.

e) Memorandum No. 2 submitted by the U.S. Representative, dealing with the functions and powers of the proposed atomic development authority, submitted July 5.

f) Analysis of the relationship between organized measures for the international control of atomic energy and the United Nations organization (particularly the Security Council) by the Chairman of the Commission, Dr. Herbert V. Evatt, (Australia), submitted July 8.

The procedure in Sub-Committee No. as informal throughout and no votes e taken. The observations which fol- are therefore made upon my own re-nsibility in order to assist the future k of the Commission.

Three important questions of principle iled consideration of which will be ntial before any final plan can be fted, were examined during the dis-ions. There may be stated as follows:

OPOSED INTERNATIONAL NVENTION

Whether it is desirable to negotiate an international convention dealing solely with the "outlawing" of atomic weapons and the destruction of existing stocks, or whether on the other hand, the obligation not to make or use such weapons should be included within the framework of a broad general plan, an essential part of which should be an effective system of controls to make sure that atomic energy would be employed for peaceful purposes only. The opinion of the majority of the Committee favored the second alternative. Such alternative is basic to the United States proposals as explained by their representative in the Sub-Committee and also by Mr. Baruch in his opening address. Moreover, for reasons which I mention below (paragraph 9), I am of the opinion that the second alternative is the only course which is really consistent with the terms of reference of the Atomic Energy Commission itself. (Assembly Resolution Paragraph 5 (b) and (d)).

INTERNATIONAL CONTROL

B. The general type of international controls and measures necessary for inclusion within the framework of a general plan, including in such controls the establishment of a special international agency vested with executive power to determine and enforce controls and also to promote development of atomic energy for peaceful purposes.

The general type of possible control measures and the functions of such an international agency are indicated with clarity in the United States documents (d) and (e) listed in Paragraph 5 above.

RELATIONSHIP OF CONTROLS TO U.N.O.

C. The relationship between organized measures for the international control of atomic energy and the United Nations organization, particularly the Security Council.

As to this a juristic analysis of the legally permissible and practicable principles of relationship is contained in the Australian document (f) listed in Paragraph 5 above. This document was prepared by me on the hypothesis that the United Nations Charter remains for the time being in its present form. The Australian delegation has always favored at least the limitation of the veto power to the specific sanctions (e.g. commercial boycott, the levying of war by the United Nations against a proved aggressor) which the Security Council may impose under Chapter VII of the Charter. Indeed Australia took a leading part in the proposals made at the San Francisco Conference to restrict the veto, and recent experience confirms the wisdom of such proposals. However, in order to make specific proposals "with the utmost despatch" for the limitation of the use of atomic energy to peaceful purposes, practical common sense dictates that such specific proposals should not be dependent for their efficacy upon the remote possibility of complete and prompt removal from the Charter of the veto upon sanctions, a veto which is possessed by each permanent member of the Council.

PLACE OF CONTROLS IN THE INTERNATIONAL PLAN

8. As regards the first question, above, all members of the Sub-Committee agreed in principle that at a stage to be determined, an international agreement not to produce or use atomic weapons for purposes of war, should be entered into. It was contended by the representative of the U.S.S.R. that an agreement of this kind should be entered into immediately, i.e. before the establishment of a general plan for an effective international control of atomic energy. However, the majority of the Sub-Committee (including the U.S., which alone possesses atomic weapons) were strongly of the opinion

(a) that a mere convention outlawing the use of atomic weapons could not be regarded as adequate, especially having regard to past experience of the inefficacy of certain international pacts,

(b) that atomic weapons could and should be eliminated by direct measures of inspection and control and

(c) that this system of control would make the proposed convention largely superfluous while ensuring the carrying into effect of its disarmanent objectives.

NEED FOR EFFECTIVE GUARANTEES

9. This conclusion appears inescapable if due account is taken of the instruction given to the Atomic Energy Commission in Paragraph 5(b) of the resolution adopted by the General Assembly on 24th January, 1946, i.e. to "make specific proposals for the control of atomic energy to the extent necessary to ensure its use only for peaceful purposes". It is clear that a convention unaccompanied by controls could not possibly be regarded as sufficient to "ensure" the use of atomic energy for peaceful purposes only. That objective can be achieved only by effective controls and guarantees amounting to a practical physical certainty that atomic bombs will not be used for military purposes because they cannot be brought into existence. As between continous and positive controls (including inspection), and a mere convention to disarm (which at present would apply in fact only against the United States), the Assembly impliedly preferred the former course. That course is in accordance with the assessment of the situation made by the majority of the Sub-Committee solely in a desire to reach a satisfactory solution of a great problem.

10. It seems to follow that in order to arrive as rapidly as possible at the stage where atomic weapons can be eliminated effectively and permanently, it is essential to proceed with the detailed preparation of an adequate system of international control. This system is an integral feature of the Baruch plan and in the opinion of the majority of the Commission as expressed in the public and private discussions, it is demonstrably just and equitable in the interests of all humanity.

MEASURES FOR INTERNATIONAL CONTROL

11. The Sub-Committee discussed in general terms the measures suggested by the United States for the control of atomic energy. The United States representative contended, and this view found strong support in the Sub-Committee, that effective control can be ensured only by the establishment of an atomic energy agency with broad powers of ownership, managerial control and supervision, leasing, licensing and inspection.

POWERS AND FUNCTIONS OF ATOMIC ENERGY AGENCY

12. There was also considerable support for the view that this agency should—

(a) have power to obtain complete control over or ownership of all uranium, thorium, or other potential source of atomic energy;

(b) be empowered to conduct investigations and surveys of sources of atomic energy;

(c) own or rigidly control all facilities for the production of U235, plutonium and such other fissionable materials as it determines to be dangerous;

(d) control such other facilities and activities in the field of atomic energy as would be dangerous in other hands;

(e) have free and unhindered access to and power to control, license and inspect all other facilities which possess, utilize or produce the materials which are a source of atomic energy;

(f) have the exclusive right of research in the field of atomic explosives;

(g) foster and promote the non-dangerous use and wide distribution of atomic energy for beneficial purposes under licenses or other suitable arrangements that it may establish;

(h) be authorized to make and issue such rules and regulations and take such action as is necessary to accomplish the purposes assigned to it.

13. It was clear from our discussions that it is essential to proceed at once to a more detailed examination of actual control measures and their applications. What next should be considered are specific proposals rather than statements of principle. When this is completed, it should be possible to make progress toward resolving the difficult questions of the precise functions and powers of the atomic energy agency and its precise relationship with the organs of the United Nations, in particular the Security Council.

RELATIONSHIP TO THE UNITED NATIONS

14. In the Sub-Committee there was general support of the view that if the system of control was inaugurated, it should be established by a single treaty which would define the obligations to be accepted by member States and at the same time establish the control agency, and define its form of organisation, functions and powers. So far as necessary the same instrument could define the relationship between the agency and the various organs of the United Nations. Further study is required to define exactly what that relationship should be. It seems to me clear, however, that the control agency must be constituted in such a way that it can, within its defined powers of inspection and control, act without undue delay.

15. The questions of the "sanctions" which such an atomic energy agency should be authorised to impose, the voting procedures within the atomic energy agency, and the division of functions between such an agency and the Security Council of the United Nations are all difficult, but they must be faced and overcome. That can be done only by a continuance of the frank exchange of views which have characterised the work of the Sub-Committee.

16. It was suggested during the Sub-Committee discussions by the delegate of the U.S.S.R. that it is or may be unnecessary to confer enforcement powers on an atomic energy agency, because any necessary enforcement action could be taken by the Security Council. While it is generally recognised that the Security Council must retain its defined executive powers so long as the Charter of the United Nations remains in its present form, it is in my opinion legally and practically impossible for the functions of the Security Council to be enlarged in order to include the multifarious and detailed executive decisions involved in the administration of a treaty providing for the control and development of atomic energy. In my opinion, the Security Council has, under the United Nations Charter, no executive powers of such a character. Its executive powers exist only in situations where a threat to the peace, breach of the peace or act of aggression has been proved to exist in accordance with Chapter VII.

17. The urgent problem facing us is devise means by which power may be giv by an international treaty to an ator energy agency to control and superv atomic energy development in such a w that neither threats to the peace r breaches of the peace nor acts of aggr sion can be caused by the employment atomic weapons. In other words our jective is to make the control system effective that plans for violation evasion—whether of a major or mi character—may be detected at the earli stages and prompt measures taken effective prevention.

18. If, however, the control system the international agency were in particular case shown to be inadequ or ineffective, the machinery of the curity Council could be invoked either b complainant State or if it were so agre by the atomic energy agency whenever special situations mentioned in Chap VII of the United Nations Charter seem likely to occur.

THE VETO

19. I return to a frank consideration the veto. Mr. Baruch, in his open speech, said "I want to make it very pl that I am concerned here with the v power only as it affects this particu problem. There must be no veto to p tect those who violate their sole agreements not to develop or use ato energy for destructive purposes". behalf of Australia I have endorsed statement which I do not interpret a demand for an amendment of the Un Nations Charter in relation to the met of voting in the Security Council w that body is dealing with the imposi of sanctions under Chapter VII. In p of fact such an amendment would legally impossible without the con of each one of the five permanent m bers: for the individual "veto" in res of voting in the Security Council is tected by the individual veto in respec United Nations Charter amendment.

20. I also interpret the remarks of Gromyko that "efforts directed to un mine the unanimity of the Members of Security Council upon questions of stance are incompatible with the inter of the United Nations" as indicatin resolve on the part of the U.S.S.R. to consent to any alteration of the Cha at least so far as it affects voting in Security Council on questions of sanct under Chapter VII.

21. I am convinced that in the end solution of our task will be in the prep tion, for submission first to the Secu Council and eventually to the Ur Nations, of a multilateral treaty emb ing four vital subject matters i.e.

(a) an overall plan for internati

control of atomic energy and its development for peaceful purposes;

(b) the charter of an international atomic energy agency with wide powers to administer the plan and put it into effect;

(c) obligations by member States not to use atomic energy for purposes of destruction, and

(d) terms and conditions under which the several parts of the plan shall become operative in just and equitable sequence.

2. It seems to me plain that the broad rinciple, advocated so strongly by Mr. aruch as U.S. Representative in the bove quoted words, would be carried into ubstantial effect provided it is undertood from the outset that every party to he atomic energy treaty will be subject the rules of conduct laid down either the treaty itself or by the international ontrolling agency established by such reaty. It follows from the same principle f the rule of law that no system of eto could possibly be permitted in the rocedure of the atomic energy agency, imply because that would mean a right r privilege to claim a special immunity r exemption from the rules and regulaions of conduct, thus subverting the main purposes of the overall plan. For uch reasons each and every nation entering into the atomic energy treaty must e bound by all its obligations.

3. It is apparent that there are two ays in which the binding effect of the ystem of international controls could be vaded and practical immunity from its eneral rules gained by a nation. The first method would be to include openly and irectly in the proposed treaty provisions or granting such immunity to one or more nations. But it is evident that the reat majority of the nations could not e expected to endorse privileges and mmunities which would destroy the practical effectiveness of international control.

4. The second method of achieving the ame result would be by way of indirecion, i.e. to confer upon the Security Counl the additional function of administering he control system. In this second case the esult would be that each permanent member of the Security Council, by exercising he existing privilege of veto, could in ffect confer immunity upon itself or any ther country in any particular case of nforcement of controls. This second inirect method seems as inadmissible as he first and as little likely to secure genral acceptance.

5. For these reasons it will, in my view, ecome increasingly apparent that in order carry out the principles of the Baruch roposals and the mandate given to the tomic Energy Commission by the Assemly, a special international agency for atomic control and development will have to be established by multilateral treaty—such agency being vested with administrative and executive powers, and being made responsible to the signatory nations and also brought into special relationship with the United Nations Organization.

After July 12, the "Sub-Committee 1" was replaced by "Committee No. 2", which had, as its terms of reference:

"To examine questions associated with the control of atomic energy activities including all measures designed to insure the prevention of the use of atomic energy for purposes of destruction, and other weapons of mass destruction, and also including subject matters of possible Conventions, Sanctions and Observance, and to make specific recommendations of the said subjects."

It consisted of one representative of each country on the Atomic Energy Commission.

Another Committee established by the Working Committee on the same date was the Legal Advisory Committee, consisting of representatives of all twelve delegations, whose terms of reference were as follows:

"To act as an auxiliary to the Working Committee and other Committees in respect of all legal matters and to advise on all drafting questions. The Committee would also examine 1) the legal aspects of the relationships between the system of measures of control recommended by Committee No. 2 and the United Nations, and 2) will ultimately submit a draft treaty or treaties to the Working Committee."

Finally, a Scientific and Technical Committee was established consisting of one scientific adviser appointed by each of the twelve countries represented on the Atomic Energy Commission.

"To advise the Working Committee and all other Committees or the Commission on scientific and technical questions referred to us. Also a) to consider and recommend proposals for the exchange of information; b) to consider and recommend proposals for the peaceful uses of atomic energy; and c) to consider and recommend proposals on all scientific and technical matters connected with the activities of the Commission.

On July 24, Mr. Gromyko presented, before "Committee No. 2", a speech which referred specifically to the American memorandum, No. 3, and can be considered as the final statement in this stage of deliberations. No full transcript of this speech is available; we report it from the official UN press release. Mr. Gromyko said that he wished to make some observations on the substance of the United States Memorandum No. 3, submitted to the former Sub-Committee No. 1 of the Atomic Energy Commission on July 12.

Mr. Gromyko began his observations by stating that he attached great importance to the question whether or not the existing organs of the United Nations are empowered to deal with problems of control over atomic energy. Whereas the United States memorandum states that existing organs of the United Nations are not empowered to deal with the questions relating to the control of atomic energy, the USSR feels that "such conclusions cannnot be justified." The United Nations Charter mentions no specific type of arms which might be used by an aggressor, but deals with this subject in general terms, and grants to the Security Council full power and rights to deal with such matters. That is, the Security Council "is able and has full power" to deal with these questions; the Atomic Energy Commission was established to assist the Security Council in these matters, but the Council should make all final decisions.

In respect to decisions relating to the control of atomic energy and to decisions to be made by an Atomic Development Authority, as proposed by the United States representative, the United States memorandum drew up three categories (administrative matters, procedural matters and serious offenses). **These proposals "are of such a character that in reality such an Authority would be independent of the Security Council and would have almost full autonomy. This cannot be reconciled with the Charter of the United Nations."**

The United States memorandum realizes, said Mr. Gromyko, that the broad functions and powers of the Atomic Development Authority in the field of control, inspection and in other fields are difficult to reconcile with the relevant provisions of the Charter ensuring the sovereignty of Member States of the United Nations. The United States proposed therefore that all matters related to atomic energy should be considered as matters of international and not of national importance and jurisdiction in order to make Article 2(7) of the Charter of the United Nations inapplicable to matters of atomic energy. Mr. Gromyko stressed that "when the Charter of the United Nations was prepared by the Conference at San Francisco, the question of sovereignty was one of the most important questions considered. **This principle of sovereignty is one of the cornerstones on which the United Nations structure is built; if this were touched the whole existence and future of the United Nations would be threatened."**

In respect to the relationship between the Atomic Development Authority and

the General Assembly of the United Nations, said Mr. Gromyko, it is to be noted that there were no proposals in the United States memorandum which "would mean weakening the provisions by which the rights and functions of the General Assembly are assured." This is right, stated Mr. Gromyko, since the powers of all organs of the United Nations must be protected. While the rights of the General Assembly were not minimized, on the other hand the United States memorandum denied the Security Council the rights it should have under the Charter. Such a situation could not be considered as normal. The position of the Soviet Government was that the power, authority and prestige of the Security Council should not be undermined in connection with the problem of atomic energy.

Mr. Gromyko declared further that the United States proposals also "change entirely the meaning of Article 51 of the Charter."

On the question of the voting procedure in the Security Council Mr. Gromyko said: "on this question also I should like to make again clear the position of the Soviet Union that we cannot accept any proposals that would undermine in any degree the principle of the unanimity of the permanent members of the Security Council in the maintenance of peace and security." Mr. Gromyko noted that he had already made the position of the Soviet Government on this question quite clear at the second meeting of the Atomic Energy Commission and that he thought it would be dangerous and perhaps fatal to undermine this principle which was embodied in the Charter of the United Nations at San Francisco in recognition of its necessity for maintaining peace and security. The great powers, said Mr. Gromyko, will provide the main means against aggression, and this was recognized in the San Francisco decision on the voting procedure in the Security Council.

In conclusion Mr. Gromyko said: **"the United States proposals (referring to United States Memorandum No. 3) in their present form cannot be accepted in any way by the Soviet Union either as a whole or in separate parts."**

* * *

This speech squelched, at least temporarily, all hopes of reaching agreement with USSR on the establishment of an Atomic Development Authority largely independent of the Security Council, and endowed with discretionary power of its own.

THIRD STAGE—DISCUSSION OF THE SOVIET PLAN

In the third part of the deliberations of the UN Atomic Energy Commission, attention was switched from the American ADA plan to the Russian proposal. Mr. Gromyko was invited to develop his plan in more detail, in the expectation that after a month's debate, which had revealed universal desire for an effective implementation of any agreement on outlawry of atomic weapons, he might enlarge on the means by which the USSR proposes to enforce the Convention on Prohibition of Atomic Weapons which Gromyko suggested on June 19. This expectation was not fulfilled; Mr. Gromyko merely restated his previous position. Instead of making concessions to the principle of effective control and enforcement of the agreement by an international agency, he praised the principle by which each sovereign nation would enforce the covenant within its own borders.

The disappointment over this stubbornness of Mr. Gromyko's attitude found expression in the next speech by the representative of Holland.

The speech of Mr. Gromyko is reprinted in full below; that of Mr. Van Kleffens appears on p. 31.

SOVIET ATOM CONTROL PLAN
A. GROMYKO (RUSSIA)

At the second meeting of the Atomic Energy Commission I proposed in the name of the Soviet government the conclusion of a convention outlawing the production and use of atomic weapons for purposes of mass destruction. The Soviet government attaches great importance to the conclusion of such a convention.

It is impossible to consider practically the control over atomic energy without considering at this time the question of the conclusion of a convention outlawing the production and use of atomic weapons There are no serious obstacles to the conclusion of such a convention if the countries on the Atomic Energy Commission really and sincerely wish to take practical steps toward the control of atomic energy and for its use for peaceful purposes only. The only obstacle could be the wish not to place all discussions on a practical basis with the purpose of finding a practical solution of the problem.

The task is made easier by historic precedents: Civilization gives the example that countries, if they wish, can conclude conventions against the use of weapons for mass destruction. Such a convention was concluded with regard to gases and other poisonous substances and liquids.

The task of concluding such a convention is not so complicated if we really desire to prevent the use of atomic energy as a weapon.

The Soviet draft convention contains also concrete points. For instance, Paragraph B, Article 1, which provides that the production of atomic weapons be forbidden and that their production as well as their use shall be considered a serious offense against humanity. Thus one of the first steps toward the realization of control over atomic energy is the prohibition of the production of atomic weapons.

The main task of the Atomic Energy Commission, according to the resolution of the General Assembly, is to insure that atomic energy should not be used for purposes of mass destruction. If all countries agree to this, we ask how is the production of atomic weapons to be reconciled with this purpose? It is impossible to reconcile production of atomic weapons with the task of using atomic energy for peaceful purposes only and with the spirit and the principles of the United Nations.

The draft convention contains also concrete provisions providing for the destruction, within three months after its conclusion, of all stockpiles of atomic weapons and of unfinished atomic weapons. This also is a practical proposal, a step toward the solution of the problem of the use of atomic energy for peaceful purposes only. We ask why nations should produce stockpiles of atomic weapons if we all agree that atomic energy should be used only for the benefit of mankind.

The draft convention contains a provision that signatory states should within six months of its conclusion enact legislation providing for severe punishment for violations of the convention. This is wholly in accord with the seriousness of the task as well as with the principle of the sovereignty of member states and with the principles of the United Nations. It further underlines what great importance the United Nations attach to provisions for insuring the use of atomic energy only for the benefit of mankind and of science and not to the detriment of humanity. The conclusion of such a convention would, without doubt, make a very favorable impression on all peace-loving states and would promote good neighbor relations between nations.

In connection with the proposal for draft convention some details would possibly have to be elaborated by this committee or by the Atomic Energy Commission.

The Soviet proposal has, compared to those of other countries—which may, on the surface appear to be radical but cannot carry us to our goal—the merit of being a practical one, providing for the immediate and practical steps toward the control over atomic energy. The eyes of all peace-loving nations are focused on the work of the Atomic Energy Commission and the peoples of the world expect the commission to suggest to the Security Council practical measures for the control of atomic energy. Such practical measures are contained in the Soviet proposal

British Views of Atomic Energy . . . . . from "Nature"

This article is from a series of two editorials in the distinguished English scientific journal, Nature, (June 22 and June 29).

On January 7, 1946, the United States Secretary of State appointed a Committee on Atomic Energy, with Dean Acheson as chairman, to ensure that the American representative on the Atomic Energy Commission of the United Nations Organisation would be properly briefed; this Committee appointed a board of consultants which produced "A Report on the International Control of Atomic Energy." The significance of this report has evidently been appreciated by the British Government, for it has been re-issued by H. M. Stationery Office. The Atomic Scientists Association recently formed in Great Britain, has also prepared a memorandum* for submission to the Atomic Energy Commission, the recommendations of which in the main follow closely those made by the American Committee. Dr. H. E. Wimperis made a brief study, at the invitation of the Royal Institute of International Affairs, of the impact upon international relations of the new weapons, and has extended it to form a little volume, "World Power and Atomic Energy", in which, after setting the atomic bomb in its true perspective as only one of a series of scientific developments, accelerated by the War, which have been harnessed to war purposes, he reviews briefly the scientific, political, international and ethical aspects. In the purely political field, the Government has introduced its Atomic Energy Bill; and in the ethical plane a commission appointed by the British Council of Churches, under Dr. J. H. Oldham as chairman, to consider the problems created by the discovery of atomic energy, has issued a reportfi in which the moral and ethical aspects in particular are profoundly discussed, even if it is hard to find an answer to many of the questions raised. Thus the Atomic Energy Commission has useful material before it to facilitate its deliberations, on which indeed the fate of civilization may be said to depend.

THE LILIENTHAL AND ASA REPORTS

From the scientific point of view, one may well turn first to the American report, around which, as the British memorandum shows, scientific and technical discussion of the problem is likely at the moment to be centred. Moreover, the American board of consultants under the chairmanship of Mr. D. E. Lilienthal, and also the Acheson Committee responsible for it, present it not as a final plan, but as a starting-point for the informed public discussion which is one of the essential factors in developing sound policy. As pointed out by Prof. Oliphant, it provides a really constructive analysis of the question of international control, and a hopeful approach to a solution of the whole problem.

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There follows a resumé of the Lilienthal Report, with which the readers of the Bulletin may be assumed familiar.

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It is clear that the scientific workers of the United States have taken a most important step in preparing the way for their country to accept the responsibilities of leadership, which possession of so much of the technical knowledge of production in this field lays upon them; and the task of further discussion of these proposals, so far as they concern the government of the United States, and the simultaneous task of educating public opinion in that country in support of the proposed plan or a modification of it is one that they are clearly determined to discharge. But there are like responsibilities that the publication of the report places upon scientific workers in other countries, if the Lilienthal plan or any other scheme of international control is to succeed. Not merely must public opinion be prepared for the surrender of national sovereignty involved: no less important, the scientific and technical aspects of the plan must be searchingly but constructively reviewed, and alternative and constructive proposals advanced to cover any features in which it appears to be defective or unacceptable.

The recommendations of the Atomic Scientists' Association, a body of British men of science who have been associated with atomic energy projects, as set forth in a memorandum on the international control of atomic energy issued shortly after its formation, are on similar lines to those of the Lilienthal Board. An immediate attempt is urged to obtain international agreement by which the use of atomic energy, the distribution of the essential raw materials, and the erection and operation of plants designed to produce or capable of producing active materials, would be strictly controlled by the United Nations Organisation. The control would be implemented by a system of inspection, and all major sources of raw materials and major production plants would be handed over to the United Nations Organisation and operated under international boards responsible to it, and guarded by men also responsible to and appointed by that Organisation. The Atomic Energy Commission should undertake the construction and operation of new large-scale plants for the production of fissionable materials. These plants should be so distributed throughout the world as to ensure that if any nation seize control of plants operating in the area in which its own armed forces predominate, the remainder of the United Nations would jointly possess an overwhelming superiority in the production of fissionable material.

The disposal of active materials produced in such plants and the research, development and production of atomic explosives would be reserved to the United Nations Organisation, and any bombs made in that way or made prior to the scheme should be kept in stores distributed throughout the world. The Association does not commit itself to regarding the atomic bomb as a desirable or suitable weapon for police functions, but considers production and control of atomic bombs by an international authority as essential at present to prevent any ill-disposed nation holding the threat of atomic warfare over the peace-loving nations. The Association is impressed with the feasibility of the division of atomic energy activities into 'safe' and 'dangerous' categories, as suggested by the Lilienthal Board, and the memorandum also includes a recommendation in favour of lifting the secrecy rules and ultimately carrying on all research and development freely and openly, with a duty to report to the United Nations Organisation any significant results.

THE BRITISH ATOMIC ENERGY BILL

One first step to which British men of science must address themselves forthwith is the scrutiny of the Atomic Energy Bill and any other legislative or executive measures which the Government proposes to take in this field; so as to ensure that no action is taken which will impede either the work of the Atomic Energy Commission itself or the attainment of international agreement on this difficult question. The powers which the Atomic Energy Bill gives to the Minister of Supply are indeed wide, but they appear to be necessary at present, and should in fact facilitate the handing over of the specified dangerous operations to international authority in accordance with any plan on the lines suggested by the Lilienthal Board. The Bill charges the Minister with the general duty of promoting and controlling the development of atomic energy, as well as its production and use and the prosecution of research. He has power to obtain information concerning any materials, plant or processes connected with the production of atomic energy, including that of entry and inspection of premises, as well as powers of search for minerals from which uranium and other pre-

*This report was published in the Bulletin v. 1 No. 12.

scribed substances might be obtained, the right of working and powers of control over the working of any such minerals.

A further clause in the Bill restricts the disclosure, without the consent of the Minister, of information concerning any existing or proposed plant for producing or using atomic energy, the purpose or method of operation of any such plant or process, except plant designed solely for research or educational purposes. This power clearly is required as a preliminary to the ordered release of information. Similarly, the scheme outlined by the Lilienthal Board should remove the fear that scientific research at the universities may be hampered in spite of the specific exception already noted. This is probably the most substantial criticism that can be advanced against the general terms of the Bill; but it needs to be remembered that the Atomic Energy Bill, like similar legislation in the United States, while in one respect preparing the way for an international authority, in itself leaves the matter in the most dangerous position. The dangerous aspects of atomic energy must be taken out of national hands and placed in international hands quickly; and the longer the delay in establishing such an authority the greater the danger, not merely of an uncontrollable atomic armament rivalry between the nations being precipitated, but also the greater the difficulties of the transition period, to which the Lilienthal Board directs special attention.

POLITICAL ASPECTS OF CONTROL

Here, of course, we are largely entering the political field, as distinct from the technical or scientific, but the man of science or technician has a perfect right to give his views on the political conditions in which any scheme for international control can function successfully. This the Lilienthal Board has done, and there lies upon their fellow men of science the responsibility not merely of scrutinizing the technical aspects of the plan but also of ensuring that those essential political considerations, as well as the broad technical features of the scheme, are fully understood by their fellow citizens. No plan such as is proposed could wisely be undertaken unless there were valid hope that it would be entered into, and carried through, in good faith; and that in itself presupposes public understanding of the indispensable requirements of the plan.

No part of its report is more praiseworthy than that in which the Lilienthal Board endeavours to prepare public opinion in the United States for the implications of any such scheme, and the disappearance of the present monopoly, both in knowledge and physical facilities. Scientific workers already recognize that knowledge will become general; for the science on which the release of atomic energy rests is essentially a world-wide science, to which men of many countries have contributed, and the principal findings on which the success of the project depends are well known to workers in the field of nuclear physics everywhere. Further, the ultimate balance towards which a plan for international control must work will witness the loss also of material facilities, so that neither in legal possession nor in geographical distribution is any one nation unduly favoured.

But there is one point here that should be made plain. The Lilienthal Board, in proposing an international authority, is using the word in a particular sense—that of a super- or extra-national body. It does not advocate the disclosure of the critical items of fundamental knowledge or of the technique of production to national governments in the way that immediate disclosure to the United Nations Organisation would involve. What it proposes is an impartial body standing outside and above national rivalries and suspicions; and there is sound reason for the United States or Canada or Great Britain declining to impart the essential information of this type to any other body. It seems clear from the Atomic Scientists Association's memorandum that this view is shared by British men of science also, and Dr. Wimperis in his book quotes an emphatic opinion to the same effect from Prof. A. Einstein. Until the individual nations are prepared to renounce national sovereignty to that limited extent, atomic energy will continue to represent the great menace of our age, and its potentialities for good will remain an unsubstantial shadow.

While, as Prof. M. L. Oliphant has pointed out in reviewing the proposals of the Lilienthal Board for the international control of atomic energy, countries whose interest in the peaceful production of power by nuclear methods is more direct than that of countries like the United States richly endowed with coal and other sources of power, may give somewhat different emphasis to some of the points raised, there can be no dissent as to the urgency of the whole problem. If political dilatoriness and self-seeking lead to obstruction and lack of agreement, the Lilienthal proposals and any like scheme may, as Prof. Oliphant remarks, instead of saving the world, have precisely the opposite effect. It is therefore encouraging to note that both the British and Canadian delegates on the Atomic Energy Commission have already signified the support of their Governments for the general principles of the American scheme based on the work of the Lilienthal Board.

It is at this stage that the technical and political aspects merge into the ethical plane; the moral issues raised by the utilization of nuclear energy are the mair concern of the report of a commissior appointed by the British Council o Churches, with Dr. J. H. Oldham as chairman, and including among its member Sir Walter Moberly, Prof. A. D. Ritchi and Mrs. J. L. Stocks. This report wa the first considered statement by a rep resentative group to appear in Grea Britain, although it has been followed b the statement from the Atomic Scientist Association, which includes as one of it aims the interpretation of the implica tions of the release of atomic energy t other men of science and to the genera public. The report from the British Coun cil of Churches has little to say on prac tical policy, but seeks to determine th principles on which policy should be base In particular, it challenges men to fre themselves from the tyranny of habit an of accustomed ways of thinking.

THE REPORT OF THE OLDHAM COMMISSION

The Oldham Commission, as it may b termed, endeavours to keep in balanc the two aspects of the release of atomi energy, which it points out is the cul minating point of a process of continu ously increasing control of the forces o Nature which has been proceeding fo two or three generations; it does not s much present us with new problems a make more acute and urgent problem already before us for which a solutio would in any event have been imperativ Society is now confronted with no les than an immediate threat to the continu ance of civilization; and unless a wa with atomic weapons can be prevente the use for peaceful purposes of the hith erto unimagined sources of power no placed at the disposal of mankind los all importance. Before men have learne to control wisely for human good th powers which they already possess, the have had given into their hands, for goo or evil, powers of infinitely wider rang

Of the political and social consequenc of the new discovery, the Commission o serves that atomic energy is a force t powerful and dangerous to be left u controlled in private hands; and that u less, and until, effective control of weapo of mass destruction is established, eve State will have to reckon with the poss bility of a completely devastating atta made without warning, and in consequen a nation may be forced to entrust to i Government the power of immediate a tack or retaliation. Again, apart from t indirect consequences involved in such state of preparedness, the atomic bo constitutes a peculiar threat to the urb society which is the outstanding chara teristic of modern civilization. There m well also be important and far-reachi psychological effects of the intensificati of the feeling of insecurity which t

omic bomb has brought; and while the mmission recognizes the need for swift ion in the political field, it believes at a real solution of the difficulties can found only at a deeper level than that political arrangement.

The substance of this report and its ecific contribution to the debate are ntained in the four chapters in which ere are successively discussed the choice fore society, the problems of power and v, power and the international com- nity and science and society. A brief alysis of social engineering and plan- g in relation to human progress and of e contrasted attitude of withdrawal m the affairs of society—attitudes ich are tending to divide the world into posing camps—leads to a challenge to velop a responsible citizenship in line h the democratic tradition of Great itain and of Western civilization, by nstantly subjecting national organisa- n and power to the criticism and cor- tion of ideas working in men's minds, d redeeming ideals and principles from ffectiveness by supplying power and ganisation to realize and uphold them. ressing the grave dangers which attend e decay of the belief in progress, the mmission emphasizes the necessity for moral and religious motive which, in of. A. N. Whitehead's words, "can ren- r clear to popular understanding some ernal greatness incarnate in the pas- ge of temporal fact".

TEST FOR DEMOCRACY

Discussing next the conceptions of pop- ar sovereignty and the supremacy of v, and the synthesis of power and law the British national tradition, the Com- ssion maintains that the coming of omic power makes it more than ever cessary to preserve the conditions in ich human lives can grow, and in a ssage reminiscent of Lord Lindsay's cussion of the functions of the church- and the universities in his "Religion, ence and Society in the Modern World", ggests that our immediate task is to courage everywhere groups which are rning to practise democratic fellowship d are thereby becoming the nuclei of a v social consciousness. Further, since as become effective by being embodied institutions, it is a vital task in the sent crisis to preserve and foster tra- ion where it still survives, while at same time fearlessly adapting it and panding it to meet the demands of a nging society.

The achievement of democracy has been curb and discipline power, not to abol- it; but although the Commission re- rds the realization of an effective world mmunity as the most urgent task of our e and the only ideal which now offers sonable hope of eliminating from hu- n society the danger of atomic war, it does not suggest that such a world community is inevitable or easy to achieve. The obstacles are concisely indicated, and particularly the clash of irreconcilable ways of life which dominates the relations between the Anglo-Saxon world and that of the U.S.S.R. That dilemma is put as clearly as it is by Mr. J. Middleton Murry in his pamphlet "Trust or Perish"; but the Commission of the British Council of Churches does not conclude with him that Great Britain should declare that in no circumstances would we participate in another world war, and that this declaration should be made irrespective of the attempt to put the atomic bomb under international control. On the contrary, it is clear that the Commission is divided on the issue. Some at least of its members regard the problem as the provision of effective means of police action to restrain a lawless and anti-social member of the community of nations from seeking to attain its ends by violence, and that to assume that the best means of saving humanity from atomic warfare is to renounce in advance the right of defence might well prove to be a serious political miscalculation.

THE ROLE OF THE CHURCHES

The Commission does not believe that Christianity is able with its present insight to pronounce between the two alternatives, but it urges that the intolerable nature of the dilemma by which we would be confronted by an outbreak of atomic warfare is an overwhelming reason for doing all in our power to further the proposal to eliminate from the armaments of all nations weapons adaptable to mass destruction. In the following chapter it admits that the Churches must recognize more fully than they have yet done that, in regard to a host of problems of conduct in our complex society, they do not know the right answer, and that that answer will be found only through the combination of ethical insight with the support of disciplined empirical research. Equally, however, it holds that the world which is apprehended by the methods of science is not the whole of reality, and the real danger to a scientific society is in the increasing opportunities which scientific advance presents to men's power-seeking impulse, and the inevitable extension of the field of organisation in which men are less and less related to one another as responsible persons and become interchangeable units in a vast machinery of production.

To believe in the reform of human society may indeed be an act of faith, but to believe in it without a change of heart, it has truly been said, is an act of lunacy. Here on this ultimate moral plane we find little guidance as to how mankind may come to that humility of soul, the cleansing of hearts from pride, vainglory, hypocrisy and unworthy material ambitions which, Dr. Wimperis reminds us, may be part of the price that must be paid. One thing is certain: mankind must, in Mr. Murry's words, trust or perish; and one essential step to that trust must be the elimination as fully and swiftly as possible of all national claims to secrecy.

The rally of scientific opinion in favour of the free interchange of scientific information is duly acknowledged in the report of the Commission of the British Council of Churches as an event of outstanding importance. It has been made abundantly clear that free communication is the lifeblood of science, and when the Atomic Scientists' Association in its memorandum urges that, as the scheme for international control of atomic energy becomes effective, the existing secrecy rules should be lifted and that eventually all research and development should be carried on freely and openly, with a duty to report to the United Nations Organisation any significant results, it is promoting not merely the interests of science itself but also that wider understanding out of which mutual confidence grows.

THE ROLE OF THE SCIENTISTS

Powerful and unmistakable as is this support for freedom of communication—the statement also urges that the free movement and interchange of all men of science, including those working on atomic energy, be permitted and encouraged to the fullest extent—it is not support for indiscriminate or precipitate disclosure. That has been made plain alike in the American report on the International Control of Atomic Energy and in the British declaration, and also in Dr. Wimperis' little book; and nothing could be more unfortunate than any action by a responsible body of scientific men which suggested that it in any way condoned such disclosure or the violation of contract clauses. Apart from those technical questions with which the American report is concerned and to which the Atomic Scientists' Association has now given its support, there is no better way in which men of science generally can help forward the development of any scheme of effective control than by exerting themselves with the utmost determination and persistence to preserve both the integrity of science and the fullest possible freedom of communication, and to see that restrictions and secrecy regulations are relaxed or modified in response to reasoned agreement and as part of a considered plan. In that way, through exercising their own power with responsibility, men of science may make also some contribution, however slight, to the resolution of that moral dilemma which confronts both the continuance of civilization and the advancement of science.

The United Nations Educational, Scientific and Cultural Organization . . . . *Prof. W. Albert Noyes, J*

The United Nations Organization is responsible for dealing with those political matters which could give rise directly to war, but certain other organizations associated with the United Nations may, indeed, have a far reaching effect in easing the way of the politicians in the solution of their problems. It is for this reason that we desire to present a brief report on the United Nations Educational, Scientific, and Cultural Organization.

"A conference to establish a specialized Organization of the United Nations for the interchange of knowledge and the promotion of understanding" met in London at the invitation of the governments of the United Kingdom and of France on November 1, 1945. In about two weeks a constitution had been drafted, and the Final Act of the Conference was signed by the heads of the delegations on November 16. Thus was laid the basis for UNESCO, but there remains ratification by the various participating nations.

PRELIMINARY ORGANIZATION

Time and space do not permit a detailed discussion of the actions taken by the aforementioned conference, but a few facts concerning the establishment of UNESCO are pertinent. The Secretariat will be in Paris, but for the moment the Secretariat of the Preparatory Commission charged with the responsibility of drawing plans for the ultimate organization is situated in London and is headed by Julian Huxley, biologist.

The Constitution recommends the establishment in each country of a National Commission to advise its government on policies with respect to UNESCO. However, since the American commission cannot be formed until the passage of authorizing legislation,* the Department of State established some months ago an advisory group in science consisting of seven men representing major fields of science. This group has held numerous meetings and has discussed the plans which it believes the United States should favor as part of the program of UNESCO.

The secretariat of the Preparatory Commission of UNESCO has been divided into nine divisions. The one which concerns us most is the Division of Natural Sciences whose chief counselor is Joseph Needham of Cambridge University, biochemist.

In order to obtain ideas which might form the basis for the ultimate program, each division has called together a committee of one or more advisers from each nation for a two-day meeting in London. It was the privilege of the writer to attend the meeting of the Committee on Natural Sciences of the Preparatory Commission on May 31 and June 1 at 46 Belgrave Square, London. Advisers from 15 nations were present.

DIFFERENCES OF OPINION

Before giving a summary of the actions taken at this meeting, it may be advisable to indicate some of the differences in point of view which are encountered in the various countries. There are those who believe that existing international agencies, such as the International Scientific Unions and their Council of Scientific Unions, could suffice for maintaining all necessary international contacts. This type of person seems averse to the adoption of any far-reaching program for UNESCO and expresses some suspicion that UNESCO might lead to an undesirable regimentation in science.

Opposed to the conservatives mentioned in the preceding paragraph are those who believe that UNESCO should operate international laboratories, have commissions dealing with a wide diversity of subjects, and in general be a powerful organization for coordinating scientific activities in the various countries. Cooperation with certain, at least, of the existing international unions is desirable. Indeed, some type of international organization now exists to deal with every conceivable problem. Most such organizations have been ineffective because of lack of funds, lack of proper personnel, or because of jealousies of one sort or another. However, such persons believe that most of these organizations should be discarded and a strong centralized agency such as UNESCO be established.

The attitude in the United States probably falls in a third category, that of ignorance. A relatively small proportion of American scientists seem to have heard of UNESCO and to know what its objectives are. The others must be educated. Of those who have thought about the subject, a majority seem to favor a strong organization.

It is obvious in dealing with this problem that we must keep the ideals of those who desire a high degree of international cooperation, and yet retain the sound judgment necessary to the establishment of a workable organization. Ideals of themselves are of little use unless there are persons at the helm who are capable of putting those ideals into practice. These truisms must be kept in mind in considering the actions of the Committee on Natural Sciences at the London meeting.

LONDON MEETING

No formal votes were taken at the me ing. There was a free and sometin heated discussion of many of the poir and usually one could sense that gene agreement was attained. However, so of the points were so vague and so idea tic that even though general agreem was obtained, it was impossible to visual any mechanism for carrying the desi of the group into effect in the near futu

It scarcely seems necessary to disc all of the propositions and the attitudes those present in detail. There were c tain general matters with which no sci tist could disagree even while admitt that positive action would be excessiv difficult of accomplishment. Included this category would be such propositi as the following: "Assist the restoratior scientific facilities in liberated countrie "Promote plans for international collabo tion of science"; "That UNESCO everything possible to further complet free exchange of scientific knowledg "Do everything possible to establish universal language of science"; "Furt the establishment of a uniform stand of weights and measures"; "That the f importation of books, reviews of scie apparatus and instruments be part of program of UNESCO, particularly as gards hospitals and laboratories not erated for profit."

Certain of these propositions inv matters of tariff, changes in basic law certain countries, and even run cou to certain sensibilities. The restoratio facilities in liberated countries is responsibility of other agencies and though UNESCO should do what it along these lines, there seems little c positive character which could be acc plished at present. Similarly, the sub of reparations is the concern of t drafting peace treaties and was deemed to be a matter for discussion

Other matters can be the object immediate attention. It was recommer that regional offices of UNESCO be es lished to aid in exchanges of personne surveying needs of the various count and to aid in exchanges of informatio various devices. Lack of foreign curr is a serious handicap to many activi and an international organization, suc UNESCO, might be of very material in this connection.

The relationship of UNESCO to various international unions and to International Council of Scientific Un

* The US has just become a member of UNESCO by joint resolution of Congress. The President is to name five delegates and establish a 100-member national commission to advise them.

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as discussed at the meeting and private- with the president and secretary of ne Council. Some unions should be supported, others should be reorganized, and ome new ones should be formed. The ouncil should have an office associated ith the headquarters of UNESCO. It is vident that UNESCO could help revive any activities which have been dormant nce the start of the war and could aid in rengthening the unions which have been adequate in the past.

There are other United Nations organiations dealing with specific problems: od and agriculture, public health, atom- energy. The closest cooperation beveen the Division of Natural Sciences UNESCO and these organizations is sential, particularly on matters pertaing to research and exchange of scientific formation.

OINTS OF DIFFERENCE

It is best, perhaps, to dwell on one or vo points about which there was heated scussion, because it is concerning these oints that the real differences of opinion etween those who desire a strong interational organization and those who do ot became apparent. One of these points ad to do with exchange of students and scientific personnel at all levels, and nother dealt with the establishment of ternational research institutes. It can e appreciated that either of these prorams carried out on an adequate scale ould require substantial funds.

While no single delegate expressed pposition to the principle of large-scale xchange of scientific personnel, there ere those who believed that existing echanisms were adequate for accomishing all that is necessary in this reect. It is true that various foundations ready carry part of this burden, and at there are various bilateral agreeents between countries for exchanges students and of professors. However, ne speaker made a strong plea for exanging other types of persons, such as boratory technicians, mechanicians, and assblowers, so that the various techques of making apparatus could be made ore common knowledge. Another speak- explained that his country had been t off seven years by the war, and that was strongly desirous of sending a few his able young men to the United ates to learn modern physical chemry. He explained that he could not do is because the necessary foreign curncy was not available. Still other speaks expressed the belief that the scientific rizon should be broadened so that all untries may make contributions to scitific knowledge. The sending of students scientifically powerful nations and of ofessors to the scientifically weaker es would be important in alleviating e inequalities which now exist.

After an extended discussion it seemed generally agreed that UNESCO should have funds at its disposal for promoting the exchange of personnel and that these funds should be used as far as possible to raise the scientific level throughout the world. It was not meant to imply that UNESCO should displace those organizations now performing these functions, but that it should supplement them and have a broader horizon as its objective. It was felt almost universally that a beginning should be made at once even though that beginning must necessarily be a modest one, and the writer expressed the hope that the American Chemical Society might make a small donation, perhaps only $25,000, to initiate the program of exchanging chemists between the various countries.

With regard to international institutes several types were mentioned as possibilities: astronomical observatories, institutes for the study of nutrition and of natural resources in the various regions of the world, institutes for the study of epidemics and endemics, an institute for applied mathematics, institutes for the study of meteorology.

The International Astronomical Union had already proposed to Dr. Huxley the establishment of an international observatory by UNESCO. In this case the Union might well be called upon to administer such an observatory, and in some other instances existing International Unions might provide administration. However, it was strongly felt that such international institutes should bear the UNESCO name so that citizens of each of the countries would feel free to use them, not as guests but as participants.

Speakers from certain countries expressed skepticism concerning these proposals. The main reasons advanced for this attitude were difficulty of obtaining funds, shortage of scientific personnel, and belief that enough institutes are already in existence. It seems to the writer that most of these arguments are trivial and even though one admits that such a program could not be implemented until funds are available, plans should be drawn immediately. The majority of those present seemed to concur in this point of view.

As a result of this discussion it was recommended that the Preparatory Commission be requested to draw plans for international institutes of one or more of the above types, choosing the ones which seem most feasible after careful consideration of all of the factors involved.

AGREEMENTS REACHED

It seems very evident from all discussions held at this meeting that strong international organizations are desired by most countries, at least by the scientists of these countries, and that any nation which takes real initiative along these lines would have a substantial following. While there are many things which can be accomplished by a weak and small organization, such as providing better contacts, providing mechanisms for exchanges of periodicals, even providing mechanisms for obtaining foreign currency, there are others which can be accomplished only if a strong organization is established and if sufficient money is available. It may be necessary to temporize and to do those things first which can be done with the facilities at hand, but the writer firmly believes that UNESCO should be provided with a sound and thorough organization competent to handle large problems and that we should all bend our efforts in the direction of obtaining proper support by the United States Government and of furnishing men who have both the ideals and the organizational ability for the tasks at hand.

The priorities agreed upon were realistic. The establishment of a sound organization and the performance of such tasks as do not require a large expenditure of funds must, necessarily, come first. But plans should be made for a more farreaching program and the first steps taken to secure proper support by the various governments.

There are some things which we can do as citizens: educate our fellow citizens on the great desirability of a strong international scientific organization. There are other things which we can do as members of the American Chemical Society. The proposal that the Society make a small donation, say $25,000, to start exchanges of chemists will be placed before the Council and the Board of Directors at the Chicago meeting. This matter should be given the freest and fullest discussion, and it is hoped that the Society will see fit to make a modest contribution which might have far-reaching consequences in promoting international cooperation.

The Preparatory Commission meets in London during July and will consider recommendations made by the committees of the nine divisions. Thereafter the secretariat will draw formal plans for the establishment of UNESCO which we hope will take place during the month of November in Paris. It behooves all of us to watch developments and to be sure that any United States representatives represent the point of view of those who believe in international cooperation. Finally, a word of warning may be in order. Good administrators are rare, and most of them have good positions. A real personal sacrifice may be necessary on the part of those who are called to serve. Let us hope that some good administrators can be found for these tasks so important for the future of science and of humanity.

The Atomic Energy Act of 1946 . . .

The portions printed in italics are those added to the Senate Bill by the Senate-House Conference Committee. (Ed.)

DECLARATION OF POLICY

SECTION 1. (a) FINDINGS AND DECLARATION.—Research and experimentation in the field of nuclear chain reaction have attained the stage at which the release of atomic energy on a large scale is practical. The significance of the atomic bomb for military purposes is evident. The effect of the use of atomic energy for civilian purposes upon the social, economic, and political structures of today cannot now be determined. It is a field in which unknown factors are involved. Therefore, any legislation will necessarily be subject to revision from time to time. It is reasonable to anticipate, however, that tapping this new source of energy will cause profound changes in our present way of life. Accordingly, it is hereby declared to be the policy of the people of the United States that, subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace.

(b) PURPOSE OF ACT.—It is the purpose of this Act to effectute the policies set out in section 1 (a) by providing, among others, for the following major programs relating to atomic energy:

(1) A program of assisting and fostering private research and development to encourage maximum scientific progress;

(2) A program for the control of scientific and technical information which will permit the dissemination of such information to encourage scientific progress, and for the sharing on a reciprocal basis of information concerning the practical industrial application of atomic energy as soon as effective and enforceable safeguards against its use for destructive purposes can be devised;

(3) A program of federally conducted research and development to assure the Government of adequate scientific and technical accomplishment;

(4) A program for Government control of the production, ownership, and use of fissionable material to assure the common defense and security and to insure the broadest possible exploitation of the field; and

(5) A program of administration which will be consistent with the foregoing policies and with international arrangements made by the United States, and which will enable the Congress to be currently informed so as to take further legislative action as may hereafter be appropriate.

ORGANIZATION

SEC. 2 (a) ATOMIC ENERGY COMMISSION.—

(1) There is hereby established an Atomic Energy Commission (herein called the Commission), which shall be composed of five members. Three members shall constitute a quorum of the Commission. The President shall designate one member as Chairman of the Commission.

(2) Members of the Commission shall be appointed by the President, by and with the advice and consent of the Senate. In submitting any nomination to the Senate, the President shall set forth the experience and the qualifications of the nominee. The term of office of each member of the Commission taking office prior to the expiration of two years after the date of enactment of this Act shall expire upon the expiration of such two years. The term of office of each member of the Commission taking office after the expiration of two years from the date of enactment of this Act shall be five years, except that (A) the terms of office of the members first taking office after the expiration of two years from the date of enactment of this Act shall expire, as designated by the President at the time of appointment, one at the end of three years, one at the end of four years, one at the end of five years, one at the end of six years, and one at the end of seven years, after the date of enactment of this Act; and (B) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed, shall be appointed for the remainder of such term. Any member of the Commission may be removed by the President for inefficiency, neglect of duty, or malfeasance in office. Each member, except t Chairman, shall receive compensation at the rate of $15,000 per annu and the Chairman shall receive compensation at the rate of $17,5 per annum. No member of the Commission shall engage in any oth business, vocation, or employment than that of serving as a meml of the Commission.

(3) The principal office of the Commission shall be in the Distr of Columbia, but the Commission or any duly authorized represen tive may exercise any or all of its powers in any place. The Co mission shall hold such meetings, conduct such hearings, and rece such reports as may be necessary to enable it to carry out the p visions of this Act.

(4) There are hereby established within the Commission—

(A) a General Manager, who shall discharge such of administrative and executive functions of the Commission as Commission may direct. The General Manager shall be appoin by the President by and with the advice and consent of Senate, and shall receive compensation at the rate of $15,000 annum. The Commission may make recommendations to President with respect to the appointment or removal of General Manager.

(B) a Division of Research, a Division of Production, Division of Engineering, and a Division of Military Applicati Each division shall be under the direction of a Director who sh be appointed by the Commission, and shall receive compensat at the rate of $14,000 per annum. *The Director of the Divis of Military Application shall be a member of the armed for* The Commission shall require each such division to exercise su of the Commission's powers under this Act as the Commiss may determine, except that the authority granted under sect 3 (a) of this Act shall not be exercised by the Division of Resear

(b) GENERAL ADVISORY COMMITTEE. — There shall be a Gene Advisory Committee to advise the Commission on scientific and te nical matters relating to materials, production, and research development, to be composed of nine members, who shall be appoin from civilian life by the President. Each member shall hold office a term of six years, except that (1) any member appointed to fil vacancy occurring prior to the expiration of the term for which predecessor was appointed, shall be appointed for the remainder such term; and (2) the terms of office of the members first tak office after the date of the enactment of this Act shall expire, designated by the President at the time of appointment, three at end of two years, three at the end of four years, and three at the of six years, after the date of the enactment of this Act. The C mittee shall designate one of its own members as Chairman. Committee shall meet at least four times in every calendar year. members of the Committee shall receive a per diem compensatior $50 for each day spent in meetings or conferences, and all meml shall receive their necessary traveling or other expenses while enga in the work of the Committee.

(c) MILITARY LIAISON COMMITTEE.—There shall be a Mili Liaison Committee consisting of representatives of the Department War and Navy, detailed or assigned thereto, without additional c pensation, by the Secretaries of War and Navy in such numbe they may determine. The Commission shall advise and consult the Committee on all atomic energy matters which the Commi deems to relate to military applications, including the developm manufacture, use, and storage of bombs, the allocation of fission material for military research, and the control of information rela to the manufacture or utilization of atomic weapons. The Commis shall keep the Committee fully informed of all such matters be it and the Committee shall keep the Commission fully informe all atomic energy activities of the War and Navy Departments. Committee shall have authority to make written recommendation the Commission on matters relating to military applications from to time as it may deem appropriate. If the Committee at any concludes that any action, proposed action, or failure to act of Commission on such matters is adverse to the responsibilities of Departments of War or Navy, derived from the Constitution, and treaties, the Committee may refer such action, proposed ac or failure to act to the Secretaries of War and Navy. If either Secre concurs, he may refer the matter to the President, whose dec shall be final.

(d) APPOINTMENT OF ARMY AND NAVY OFFICERS.—*Notwithstan*

provisions of section 1222 of the Revised Statutes (U. S. C., 1940 on, title 10, sec. 576), section 212 of the Act entitled "An Act ng appropriations for the Legislative Branch of the Government the fiscal year ending June 30, 1933, and for other purposes", oved June 30, 1932, as amended (U. S. C., 1940 edition, title 5, 59a), section 2 of the Act entitled "An Act making appropriations he legislative, executive, and judicial expenses of the Government he fiscal year ending June thirtieth, eighteen hundred and ninety and for other purposes", approved July 31 1894, as amended S. C., 1940 edition, title 5, sec. 62), or any other law, any active etired officer of the Army or the Navy may serve as Director of Division of Military Application established by subsection (a) (4) of this section, without prejudice to his commissioned status as officer. Any such officer serving as Director of the Division of tary Application shall receive, in addition to his pay from the ed States as such officer, an amount equal to the difference between pay and the compensation prescribed in subsection (a) (4) (B) of section.

SEARCH

Sec. 3. (a) Research Assistance.—The Commission is directed to ise its powers in such manner as to insure the continued conduct esearch and development activities in the fields specified below private or public institutions or persons and to assist in the isition of an ever-expanding fund of theoretical and practical vledge in such fields. To this end the Commission is authorized directed to make arrangements (including contracts, agreements, loans) for the conduct of research and development activities ing to—

(1) nuclear processes;

(2) the theory and production of atomic energy, including processes, materials, and devices related to such production;

(3) utilization of fissionable and radioactive materials for medical, biological, health, or military purposes;

(4) utilization of fissionable and radioactive materials and processes entailed in the production of such materials for all other purposes, including industrial uses; and

(5) the protection of health during research and production activities.

Commission may make such arrangements without regard to the sions of section 3709 of the Revised Statutes (U. S. C., title 41, 5) upon certification by the Commission that such action is sary in the interest of the common defense and security, or upon wing that advertising is not reasonably practicable, and may make al and advance payments under such arrangements, and may available for use in connection therewith such of its equipment facilities as it may deem desirable. Such arrangements shall contain provisions to protect health, to minimize danger from explosion other hazards to life or property, and to require the reporting to permit the inspection of work performed thereunder, as the mission may determine; but shall not contain any provisions or itions which prevent the dissemination of scientific or technical mation, except to the extent such dissemination is prohibited by

(b) Research by the Commission.—The Commission is authorized directed to conduct, through its own facilities, activities and studies e types specified in subsection (a) above.

ODUCTION OF FISSIONABLE MATERIAL

Sec. 4. (a) Definition.—As used in this Act, the term "produce", used in relation to fissionable material, means to manufacture, uce, or refine fissionable material, as distinguished from source rials as defined in section 5 (b) (1), or to separate fissionable rial from other substances in which such material may be cond or to produce new fissionable material.

(b) Prohibition.—It shall be unlawful for any person to own any ties for the production of fissionable material or for any person roduce fissionable material, except to the extent authorized by ction (c).

(c) Ownership and Operation of Production Facilities.—

(1) Ownership of Production Facilities.—The Commission, *s agent of and on behalf of the United States,* shall be the exclusive owner of all facilities for the production of fissionable material other than facilities which (A) are useful in the conduct f research and development activities in the fields specified in ection 3, and (B) do not, in the opinion of the Commission, have potential production rate adequate to enable the operator of uch facilities to produce within a reasonable period of time a sufficient quantity of fissionable material to produce an atomic bomb or any other atomic weapon.

(2) Operation of the commission's production facilities.—The Commission is authorized and directed to produce or to provide for the production of fissionable material in its own facilities. To the extent deemed necessary, the Commission is authorized to make, or to continue in effect, contracts with persons obligating them to produce fissionable material in facilities owned by the Commission. The Commission is also authorized to enter into research and development contracts authorizing the contractor to produce fissionable material in facilities owned by the Commission to the extent that the production of such fissionable material may be incident to the conduct of research and development activities under such contracts. Any contract entered into under this section shall contain provisions (A) prohibiting the contractor with the Commission from subcontracting any part of the work he is obligated to perform under the contract, *except as authorized by the Commission,* and (B) obligating the contractor to make such reports to the Commission as it may deem appropriate with respect to his activities under the contract, to submit to frequent inspection by employees of the Commission of all such activities, and to comply with all safety and security regulations which may be prescribed by the Commission. Any contract made under the provisions of this paragraph may be made without regard to the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made under such contracts. The President shall determine at least once each year the quantities of fissionable material to be produced under this paragraph.

(3) Operation of other production facilities.—Fissionable material may be produced in the conduct of research and development activities in facilities which, under paragraph (1) above, are not required to be owned by the Commission.

(d) Irradiation of Materials.—For the purpose of increasing the supply of radioactive materials, the Commission *and persons lawfully producing or utilizing fissionable material are* authorized to expose materials of any kind to the radiation incident to the processes of producing or utilizing fissionable material.

(e) Manufacture of Production Facilities.—Unless authorized by a license issued by the Commission, no person may manufacture, produce, transfer, or acquire any facilities for the production of fissionable material. Licenses shall be issued in accordance with such procedures as the Commission may by regulation establish and shall be issued in accordance with such standards and upon such conditions as will restrict the production and distribution of such facilities to effectuate the policies and purposes of this Act. Nothing in this section shall be deemed to require a license for such manufacture, production, transfer, or acquisition incident to or for the conduct of research or development activities in the United States of the types specified in section 3, or to prohibit the Commission from manufacturing or producing such facilities for its own use.

CONTROL OF MATERIALS

Sec. 5. (a) Fissionable Materials.—

(1) Definition.—As used in this Act, the term "fissionable material" means plutonium, uranium enriched in the isotope 235, any other material which the Commission determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, or any material artificially enriched by any of the foregoing; but does not include source materials, as defined in section 5 (b) (1).

(2) Government ownership of all fissionable material.—All right, title, and interest within or under the jurisdiction of the United States, in or to any fissionable material, now or hereafter produced. shall be the property of the Commission, and shall be deemed to be vested in the Commission by virtue of this Act. Any person owning any interest in any fissionable material at the time of the enactment of this Act, or owning any interest in any material at the time when such material is hereafter determined to be a fissionable material, or who lawfully produces any fissionable material incident to privately financed research or development activities, shall be paid just compensation therefor. The Commission may, by action consistent with the provisions of paragraph (4) below, authorize any such person to

retain possession of such fissionable material, but no person shall have any title in or to any fissionable material.

(3) Prohibition.—It shall be unlawful for any person, after sixty days from the effective date of this Act to (A) possess or transfer any fissionable material, except as authorized by the Commission, or (B) export from or import into the United States any fissionable material, or (C) directly or indirectly engage in the production of any fissionable material outside of the United States.

(4) Distribution of fissionable material.—Without prejudice to its continued ownership thereof, the Commission is authorized to distribute fissionable material *owned by it* with or without charge, to applicants requesting such material (A) for the conduct of research or development activities either independently or under contract or other arrangement with the Commission, (B) for use in medical therapy, or (C) for use pursuant to a license issued under the authority of section 7. Such material shall be distributed in such quantities and on such terms that no applicant will be enabled to obtain an amount sufficient to construct a bomb or other military weapon. The Commission is directed to distribute sufficient fissionable material to permit the conduct of widespread independent research and development activity, to the maximum extent practicable. In determining the quantities of fissionable material to be distributed, the Commission shall make such provisions for its own needs and for the conservation of fissionable material as it may determine to be necessary in the national interest for the future development of atomic energy. The Commission shall not distribute any material to any applicant, and shall recall any distributed material from any applicant, who is not equipped to observe or who fails to observe such safety standards to protect health and to minimize danger from explosion or other hazard to life or property as may be established by the Commission or who uses such material in violation of law or regulation of the Commission or in a manner other than as disclosed in the application therefor.

(5) The Commission is authorized to purchase or otherwise acquire any fissionable material or any interest therein outside the United States, or any interest in facilities for the production of fissionable material, or in real property on which such facilities are located, without regard to the provisions of section 3709 of the Revised Statutes (U. S. C., title 41, sec. 5) upon certification by the Commission that such action is necessary in the interest of the common defense and security, or upon a showing that advertising is not reasonably practicable, and partial and advance payments may be made under contracts for such purposes. The Commission is further authorized to take, requisition, or condemn, or otherwise acquire any interest in such facilities or real property, and just compensation shall be made thereof.

(b) Source Materials.—

(1) Definition.—As used in this Act, the term "source material" means uranium, thorium, or any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable materials; but includes ores only if they contain one or more of the foregoing materials in such concentration as the Commission may by regulation determine from time to time.

(2) License for transfers required.—Unless authorized by a license issued by the Commission, no person may transfer or deliver,*receive possession of or title to, or export from the United States* any source material after removal from its place of deposit in nature, except that licenses shall not be required for quantities of source materials which, in the opinion of the Commission, are unimportant.

(3) Issuance of licenses.—The Commission shall establish such standards for the issuance, refusal, or revocation of licenses as it may deem necessary to assure adequate source materials for production, research, or development activities pursuant to this Act or to prevent the use of such materials in a manner inconsistent with the national welfare. Licenses shall be issued in accordance with such procedures as the Commission may by regulation establish.

(4) Reporting.—The Commission is authorized to issue such regulations or orders requiring reports of ownership, possession, extraction, refining, shipment, or other handling of source materials as it may deem necessary, except that such reports shall not be required with respect to (A) any source material prior to removal from its place of deposit in nature, or (B) quantities of source materials which in the opinion of the Commission are unimportant or the reporting of which will discourage independent propecting for new deposits.

(5) Acquisition.—The Commission is authorized and directed to purchase, take, requisition, condemn, or otherwise acquire, supplies of source materials or any interest in real property containing deposits

of source materials to the extent it deems necessary to effectua
provisions of this Act. Any purchase made under this paragraph
be made without regard to the provisions of section 3709 of th
vised Statutes (U. S. C., title 41, sec. 5) upon certification by the
mission that such action is necessary in the interest of the co
defense and security, or upon a showing that advertising is not r
ably practicable, and partial and advance payments may be made
under. The Commission may establish guaranteed prices for all
materials delivered to it within a specified time. Just compen
shall be made for any property taken, requisitioned, or conde
under this paragraph.

(6) Exploration.—The Commission is authorized to condu
enter into contracts for the conduct of exploratory operations, i
gations, and inspections to determine the location, extent, mo
occurrence, use, or conditions of deposits or supplies of source ma
making just compensation for any damage or injury occasioned th
Such exploratory operations may be conducted only with the c
of the owner, but such investigations and inspections may be con
with or without such consent.

(7) Public lands.—All uranium, thorium, and all other ma
determined pursuant to paragraph (1) of this subsection to be
arly essential to the production of fissionable material, contain
whatever concentration, in deposits in the public lands are
reserved for the use of the United States *subject to valid claims,
or privileges existing on the date of the enactment of this Act: Pro
however,* That no *individual,* corporation, partnership, or assoc
which had any part, directly or indirectly, in the development
atomic bomb project, may benefit by any location, entry, or settl
upon the public domain made after such *individual,* corpo
partnership, or association took part in such project, *if such indi
corporation, partnership, or association, by reason of having ha
part in the development of the atomic bomb project, acquire
fidential official information as to the existence of deposits o
uranium, thorium, or other materials in the specific lands upon
such location, entry, or settlement is made, and subsequent to th
of the enactment of this Act made such location, entry, or sett
or caused the same to be made for his, its, or their benefit.* The Se
of the Interior shall cause to be inserted in every patent, conve
lease, permit, or other authorization hereafter granted to use the
lands or their mineral resources, under any of which there might
the extraction of any materials so reserved, a reservation to the
States of all such materials, whether or not of commercial
together with the right of the United States through its aut
agents or representatives at any time to enter upon the land an
pect for, mine, and remove the same, making just compensati
any damage or injury occasioned thereby. Any lands so patente
veyed, leased, or otherwise disposed of may be used, and any
under any such permit or authorization may be exercised, as
reservation of such materials had been made under this subs
except that, when such use results in the extraction of any such
rial from the land in quantities which may not be transfer
delivered without a license under this subsection, such materia
be the property of the Commission and the Commission may
delivery of such material to it by any possessor thereof after su
terial has been separated as such from the ores in which it w
tained. If the Commission requires the delivery of such mate
it, it shall pay to the person mining or extracting the same, or
other person as the Commission determines to be entitled
such sums, including profits, as the Commission deems fair and
able for the discovery, mining, development, production, ext
and other services performed with respect to such material p
such delivery but such payment shall not include any amount
count of the value of such material before removal from its p
deposit in nature. If the Commission does not require delivery
material to it, the reservation made pursuant to this paragraph s
of no further force or effect.

(c) Byproduct Materials.—

(1) Definition.—As used in this Act, the term "byproduc
rial" means any radioactive material (except fissionable m
yielded in or made radioactive by exposure to the radiation i
to the processes of producing or utilizing fissionable material.

(2) Distribution.—The Commission is authorized to dis
with or without charge, byproduct materials to applicants seeki
materials for research or development activity, medical thera
dustrial uses, or such other useful applications as may be dev
In distributing such materials, the Commission shall give pre
to applicants proposing to use such materials in the conduct of r
and development activity or medical therapy. The Commissio

distribute any byproduct materials to any applicant, and shall any distributed materials from any applicant, who is not pped to observe or who fails to observe such safety standards to ct health as may be established by the Commission or who uses materials in violation of law or regulation of the Commission or manner other than as disclosed in the application therefor.

(d) GENERAL PROVISIONS.—

The Commission shall not—

(1) Distribute any fissionable material to (A) any person for a use which is not under or within the jurisdiction of the United States, (B) any foreign government, or (C) any person within the United States if, in the opinion of the Commission, the distribution of such fissionable material to such person would be inimical to the common defense and security.

(2) License any person to transfer or deliver, receive possession of or title to, or export from the United States any source material if, in the opinion of the Commission, the issuance of a license to such person for such purpose would be inimical to the common defense and security.

(3) The Commission shall establish by regulation a procedure by which any person who is dissatisfied with the distribution or refusal to distribute to him, or the recall from him, of any fissionable or byproduct materials or with the issuance, refusal, or revocation of a license to him for the transfer or receipt of source materials may obtain a review of such determination by a board of appeal consisting of three members appointed by the Commission. The Commission may in its discretion review and revise any decision of such board of appeal.

LITARY APPLICATIONS OF ATOMIC ENERGY

SEC. 6. (a) AUTHORITY.—The Commission is authorized to—

(1) conduct experiments and do research and development work in the military application of atomic energy; and

(2) engage in the production of atomic bombs, atomic bomb parts, or other military weapons utilizing fissionable materials; except that such activities shall be carried on only to the extent that the express consent and direction of the President of the United States has been obtained, which consent and direction shall be obtained at least once each year.

President from time to time may direct the Commission (1) to er such quantities of *fissionable materials or* weapons to the armed s for such use as he deems necessary in the interest of national se *or (2) to authorize the armed forces to manufacture, produce, quire any equipment or device utilizing fissionable material or ic energy as a military weapon.*

(b) PROHIBITION.—It shall be unlawful for any person to manufac- produce, transfer, or acquire any equipment or device utilizing nable material or atomic energy as a military weapon, except as be authorized by the Commission. Nothing in this subsection be deemed to modify the provisions of section 4 of this Act, or ohibit research activities in respect of military weapons, or to per- he export of any such equipment or device.

ILIZATION OF ATOMIC ENERGY

EC. 7. (a) LICENSE REQUIRED.—It shall be unlawful, except as ded in sections 5 (a) (4) (A) or (B) or 6 (a), for any person to facture, produce, or export any equipment or device utilizing nable material or atomic energy or to utilize fissionable material omic energy with or without such equipment or device, except r and in accordance with a license issued by the Commission rizing such manufacture, production, export, or utilization. No e may permit any such activity if fissionable material is produced ent to such activity, except as provided in sections 3 and 4. Nothing is section shall be deemed to require a license for the conduct of rch or development activities relating to the manufacture of such ment or devices or the utilization of fissionable material or atomic y, or for the manufacture or use of equipment or devices for cal therapy.

(b) REPORT TO CONGRESS.—Whenever in its opinion any industrial, nercial, or other nonmilitary use of fissionable material or atomic y has been sufficiently developed to be of practical value, the Com- on shall prepare a report to the President stating all the facts with ct to such use, the Commission's estimate of the social, political, mic, and international effects of such use and the Commission's mendations for necessary or desirable supplemental legislation. President shall then transmit this report to the Congress together his recommendations. No license for any manufacture, production, t, or use shall be issued by the Commission under this section until after (1) a report with respect to such manufacture, production, export, or use has been filed with the Congress; and (2) a period of ninety days in which the Congress was in session has elapsed after the report has been so filed. In computing such period of ninety days, there shall be excluded the days on which either House is not in session because of an adjournment of more than three days.

(c) ISSUANCE OF LICENSES.—After such ninety-day period, unless hereafter prohibited by law, the Commission may license such manufacture, production, export, or use in accordance with such procedures and subject to such conditions as it may be regulation establish to effectuate the provisions of this Act. The Commission is authorized and directed to issue licenses on a nonexclusive basis and to supply to the extent available appropriate quantities of fissionable material to licensees (1) whose proposed activities will serve some useful purpose proportionate to the quantities of fissionable material to be consumed; (2) who are equipped to observe such safety standards to protect health and to minimize danger from explosion or other hazard to life or property as the Commission may establish; and (3) who agree to make available to the Commission such technical information and data concerning their activities pursuant to such licenses as the Commission may determine necessary to encourage similiar activities by as many licensees as possible. Each such license shall be issued for a specified period, shall be revocable at any time by the Commission in accordance with such procedures as the Commission may establish, and may be renewed upon the expiration of such period. Where activities under any license might serve to maintain or to foster the growth of monopoly, restraint of trade, unlawful competition, or other trade position inimical to the entry of new, freely competitive enterprises in the field, the Commission is authorized and directed to refuse to issue such license or to establish such conditions to prevent these results as the Commission, in consultation with the Attorney General, may determine. The Commission shall report promptly to the Attorney General any information it may have with respect to any utilization of fissionable material or atomic energy which appears to have these results. No license may be given to any person for activities which are not under or within the jurisdiction of the United *States*, to any foreign government, *or to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security.*

(d) BYPRODUCT POWER.—If energy which may be utilized is produced in the production of fissionable material, such energy may be used by the Commission, transferred to other Government agencies, or sold to public or private utilities under contracts providing for reasonable resale prices.

INTERNATIONAL ARRANGEMENTS

SEC. 8. (a) DEFINITION.—As used in this Act, the term "international arrangement" shall mean any treaty approved by the Senate or international agreement *hereafter* approved by the Congress, during the time such treaty or agreement is in full force and effect.

(b) EFFECT OF INTERNATIONAL ARRANGEMENTS.—Any provision of this Act or any action of the Commission to the extent that it conflicts with the provisions of any international arrangement made after the date of enactment of this Act shall be deemed to be of no further force or effect.

(c) POLICIES CONTAINED IN INTERNATIONAL ARRANGEMENTS.—In the performance of its functions under this Act, the Commission shall give maximum effect to the policies contained in any such international arrangement.

PROPERTY OF THE COMMISSION

SEC. 9. (a) The President shall direct the transfer to the Commission of all interests owned by the United States or any Government agency in the following property:

(1) All fissionable material; all atomic weapons and parts thereof; all facilities, equipment, and materials for the processing, production, or utilization of fissionable material or atomic energy; all processes and technical information of any kind, and the source thereof (including data, drawings, specifications, patents, patent applications, and other sources) relating to the processing, production, or utilization of fissionable material or atomic energy; and all contracts, agreements, leases, patents, applications for patents, inventions and discoveries (whether patented or unpatented), and other rights of any kind concerning any such items;

(2) All facilities, equipment, and materials, devoted primarily to atomic energy research and development; and

(3) Such other property owned by or in the custody or control of the Manhattan Engineer District or other Government agencies as the President may determine.

(b) In order to render financial assistance to those States and localities in which the activities of the Commission are carried on and in which the Commission has acquired property previously subject to State and local taxation, the Commission is authorized to make payments to State and local governments in lieu of property taxes. Such payments may be in the amounts, at the times, and upon the terms the Commission deems appropriate, but the Commission shall be guided by the policy of not making payments in excess of the taxes which would have been payable for such property in the condition in which it was acquired, except in cases where special burdens have been cast upon the State or local government by activities of the Commission, the Manhattan Engineer District or their agents. In any such case, any benefit accruing to the State or local government by reason of such activities shall be considered in determining the amount of the payment. The Commission, and the property, activities, and income of the Commission, are hereby expressly exempted from taxation in any manner or form by any State, county, municipality, or any subdivision thereof.

CONTROL OF INFORMATION

Sec. 10. (a) Policy.—It shall be the policy of the Commission to control the dissemination of restricted data in such a manner as to assure the common defense and security. Consistent with such policy, the Commission shall be guided by the following principles:

(1) That until Congress declares by joint resolution that effective and enforceable international safeguards against the use of atomic energy for destructive purposes have been established, there shall be no exchange of information with other nations with respect to the use of atomic energy for industrial purposes; and

(2) That the dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged so as to provide that free interchange of ideas and criticisms which is essential to scientific progress.

(b) Restrictions.—

(1) The term "restricted data" as used in this section means all data concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production of power, but shall not include any data which the Commission from time to time determines may be published without adversely affecting the common defense and security.

(2) Whoever, lawfully or unlawfully, having possession of, access to, control over, or being entrusted with, any document, writing, sketch, photograph, plan, model, instrument, appliance, note or information involving or incorporating restricted data—

(A) communicates, transmits, or discloses the same to any individual or person, or attempts or conspires to do any of the foregoing, with intent to injure the United States or with intent to secure an advantage to any foreign nation, upon conviction thereof, shall be punished by *death or imprisonment for life (but the penalty of death or imprisonment for life may be imposed only upon recommendation of the jury and only in cases where the offense was committed with intent to injure the United States); or by* a fine of not more than $20,000 or imprisonment for not more than twenty years, or both;

(B) communicates, transmits, or discloses the same to any individual or person, or attempts or conspires to do any of the foregoing, with reason to believe such data will be utilized to injure the United States or to secure an advantage to any foreign nation, shall, upon conviction, be punished by a fine of not more than $10,000 or imprisonment for not more than ten years, or both.

(3) Whoever, with intent to injure the United States or with intent to secure an advantage to any foreign nation, acquires or attempts or conspires to acquire any document, writing, sketch, photograph, plan, model, instrument, appliance, note or information involving or incorporating restricted data shall, upon conviction thereof, be punished *by death or imprisonment for life (but the penalty of death or imprisonment for life may be imposed only upon recommendation of the jury and only in cases where the offense was committed with intent to injure the United States); or by* a fine of not more than $20,000 or imprisonment for not more than twenty years, or both.

(4) Whoever, with intent to injure the United States or with intent to secure an advantage to any foreign nation, removes, conceals, tampers with, alters, mutilates, or destroys any document, writing, sketch, photograph, plan, model, instrument, appliance, or no volving or incorporating restricted data and used by any indi or person in connection with the production of fissionable mater research or development relating to atomic energy, conducted b United States, or financed in whole or in part by Federal funds, o ducted with the aid of fissionable material, shall be punish *death or imprisonment for life (but the penalty of death or imp ment for life may be imposed only upon recommendation of th and only in cases where the offense was committed with intent to the United States);* or by a fine of not more than $20,000 or imp ment for not more than twenty years or both.

(5) (A) No person shall be prosecuted for any violation this section unless and until the Attorney General of the United has advised the Commission with respect to such prosecutio no such prosecution shall be commenced except upon the e direction of the Attorney General of the United States.

(B) (i) No arrangement shall be made under Section 3, no co shall be made or continued in effect under section 4, and no shall be issued under section 4 (e) or 7, unless the person with such arrangement is made, the contractor or prospective cont or the prospective licensee agrees in writing not to permit any in ual to have access to restricted data until the Federal Bureau vestigation shall have made an investigation and report to the mission on the character, associations, and loyalty of such indi and the Commission shall have determined that permitting person to have access to restricted data will not endanger the co defense or security.

(ii) Except as authorized by the Commission in case of emer no individual shall be employed by the Commission until the F Bureau of Investigation shall have made an investigation and to the Commission on the character, associations, and loyalty o individual.

(iii) Notwithstanding the provisions of subparagraphs (i (ii), during such period of time after the enactment of this may be necessary to make the investigation, report, and determi required by such paragraphs, (a) any individual who was per access to restricted data by the Manhattan Engineer District n permitted access to restricted data and (b) the Commissio employ any individual who was employed by the Manhattan En District.

(iv) To protect against the unlawful dissemination of res data and to safeguard facilities, equipment, materials, and othe erty of the Comission, the President shall have authority to the services of any Government agency to the extent he may necessary or desirable.

(C) All violations of this Act shall be investigated by the Bureau of Investigation of the Department of Justice.

(6) This section shall not exclude the applicable provisi any other laws, except that no Government agency shall ta action under such other laws inconsistent with the provisions section.

(c) Inspections, Records, and Reports.—The Commissi

(1) authorized by regulation or order to require such and the keeping of such records with respect to, and to for such inspections of, activities and studies of types speci section 3 and of activities under licenses issued pursuant to 7 as may be necessary to effectuate the purposes of this Act

(2) authorized and directed by regulation or order to regular reports and records with respect to, and to prov frequent inspections of, the production of fissionable m in the conduct of research and development activities.

PATENTS AND INVENTIONS

Sec. 11. (a) Production and Military Utilization.

(1) No patent shall hereafter be granted for any invent discovery which is useful solely in the production of fissionabl rial or in the utilization of fissionable material or atomic ene a military weapon. Any patent granted for any such invent discovery is hereby revoked, and just compensation shall be therefor.

(2) No patent hereafter granted shall confer any right respect to any invention or discovery to the extent that such in or discovery is used in he production of fissionable material or utilization of fissionable material or atomic energy for a weapon. Any rights conferred by any patent heretofore gran any invention or discovery are hereby revoked to the extent th invention or discovery is so used, and just compensation s made therefor.

(3) Any person who has made or hereafter makes any invention discovery useful in the production of fissionable material or in the lization of fissionable material or atomic energy for a military weap- shall file with the Commission a report containing a complete scription thereof, unless such invention or discovery is described in application for a patent filed in the Patent Office by such person thin the time required for the filing of such report. The report vering any such invention or discovery shall be filed on or before ichever of the following is the latest: (A) The sixtieth day after the te of enactment of this Act; (B) the sixtieth day after the completion such invention or discovery; or (C) the sixtieth day after such rson first discovers or first has reason to believe that such invention discovery is useful in such production or utilization.

(b) Use of Inventions for Research.—No patent hereafter granted ll confer any rights with respect to any invention or discovery to extent that such invention or discovery is used in the conduct of earch or development activities in the fields specified in Section 3. y rights conferred by any patent heretofore granted for any inven- n or discovery are hereby revoked to the extent that such invention discovery is so used, and just compensation shall be made therefor.

(c) Nonmilitary Utilization.—

(1) It shall be the duty of the Commission to declare any patent be affected with the public interest if (A) the invention or dis- ery covered by the patent utilizes or is essential in the utilization fissionable material or atomic energy; and (B) the licensing of h invention or discovery under this subsection is necessary to ectuate the policies and purposes of this Act.

(2) Whenever any patent has been declared, pursuant to para- ph (1), to be affected with the public interest

(A) The Commission is hereby licensed to use the invention or discovery covered by such patent in performing any of its powers under this Act; and

(B) Any person to whom a license has been issued under section 7 is hereby licensed to use the invention or discovery covered by such patent to the extent such invention or discovery is used by him in carrying on the activities authorized by his license under section 7.

e owner of the patent shall be entitled to a reasonable royalty fee any use of an invention or discovery licensed by this subsection. h royalty fee may be agreed upon by such owner and the licensee, in the absence of such agreement shall be determined by the Com- ssion.

(3) No court shall have jurisdiction or power to stay, restrain, or erwise enjoin the use of any invention or discovery by a licensee, the extent that such use is licensed by paragraph (2) above, on the und of infringement of any patent. If in any action for infringe- nt against such licensee the court shall determine that the defendant exercising such license, the measure of damages shall be the royalty determined pursant to this section, together with such costs, erest, and reasonable attorney's fee as may be fixed by he court. no royalty fee has been determined, the court shall stay proceeding until the royalty fee is determined pursant to s section. If any such licensee shall fail to pay such royalty fee, the entee may bring an action in any court of competent jurisdiction such royalty fee, together with such costs, interest, and reasonable orney's fees as may be fixed by the court.

(d) Acquisition of Patents.—The Commission is authorized to rchase, or to take, requisition, or condemn, and make just com- sation for, (1) any invention or discovery which is useful in the duction of fissionable material or in the utilization of fissionable terial or atomic energy for a military weapon, or which utilizes or essential in the utilization of fissionable material or atomic energy, (2) any patent or patent application covering any such invention discovery. The Commissioner of Patents shall notify the Commission all applications for patents heretofore or hereafter filed which in his nion disclose such inventions or discoveries and shall provide the mmission access to all such applications.

(e) Compensation Awards, and Royalties.

(1) Patent compensation board.—The Commission shall designate Patent Compensation Board, consisting of two or more employees the Commission, to consider applications under this subsection.

(2) Eligibility.

(A) Any owner of a patent licensed under subsection (c) (2) or any licensee thereunder may make application to the Commission for the determination of a reasonable royalty fee in accordance with such procedures as it by regulation may establish.

(B) Any person seeking to obtain the just compensation provided in subsections (a), (b), or (d) shall make application therefor to the Commission in accordance with such procedures as it may by regulation establish.

(C) Any person making any invention or discovery useful in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon who is not entitled to compensation therefor under subsection (a) and who has complied with subsection (a) (3) above may make application to the Commission for, and the Commission may grant, an award.

(D) Any person making application under this subsection shall have the right to be represented by counsel.

(3) Standards.

(A) In determining such reasonable royalty fee, the Commission shall take into consideration any defense, general or special, that might be pleaded by a defendant in an action for infringement, the extent to which, if any, such patent was developed through federally financed research, the degree of utility, novelty, and importance of the invention or discovery, and may consider the cost to the owner of the patent of developing such invention or discovery or acquiring such patent.

(B) In determining what constitutes just compensation under subsection (a), (b), or (d) above, the Commission shall take into account the considerations set forth in paragraph (A) above, and the actual use of such invention or discovery, and may determine that such compensation be paid in periodic payments or in a lump sum.

(C) In determining the amount of any award under paragraph (2) (C) of this subsection, the Commission shall take into account the considerations set forth in paragraph (A) above, and the actual use of such invention or discovery. Awards so made may be paid by the Commission in periodic payments or in a lump sum.

(4) Judicial review. Any person aggrieved by any determination of the Commission of an award or of a reasonable royalty fee may obtain a review of such determination in the Court of Appeals for the District of Columbia by filing in such court, within thirty days after notice of such determination, a written petition praying that such determination be set aside. A copy of such petition shall be forthwith served upon the Commission and thereupon the Commission shall file with the court a certified transcript of the entire record in the proceeding, including the findings and conclusions upon which the determination was based. Upon the filing of such transcript the court shall have exclusive jurisdiction upon the record certified to it to affirm the determination in its entirety or set it aside and remand it to the Commission for further proceedings. The findings of the Commission as to the facts, if supported by substantial evidence, shall be conclusive. The court's judgment shall be final, subject, however, to review by the Supreme Court of the United States, upon writ of certiorari on petition therefor under section 240 of the Judicial Code (U. S. C., title 28, sec. 347), by the Commission or any party to the court proceeding.

GENERAL AUTHORITY

Sec. 12. (a) In the performance of its functions the Commission is authorized to—

(1) establish advisory boards to advise with and make recommendations to the Commission on legislation, policies, administration, research, and other matters;

(2) establish by regulation or order such standards and instructions to govern the possession and use of fissionable and byproduct materials as the Commission may deem necessary or desirable to protect health or to minimize danger from explosions and other hazards to life or property;

(3) make such studies and investigations, obtain such information, and hold such hearings as the Commission may deem necessary or proper to assist it in exercising any authority provided in this Act, or in the administration or enforcement of this Act, or any regulations or orders issued thereunder. For such purposes the Commission is authorized to administer oaths and affirmations, and by subpena to require any person to appear and testify, or to appear and produce documents, or both, at any designated place. No person shall be excused from complying with any requirements under this paragraph because of his privilege against self-incrimination, but the immunity provisions of the Compulsory Testimony Act of February 11, 1893 (U. S. C., title 49, sec. 46), shall apply with respect to any individual who specifically claims such privilege. Witnesses subpenaed under this

subsection shall be paid the same fees and mileage as are paid witnesses in the district courts of the United States;

(4) appoint and fix the compensation of such officers and employees as may be necessary to carry out the functions of the Commission. Such officers and employees shall be appointed in accordance with the civil-service laws and their compensation fixed in accordance with the Classification Act of 1923, as amended, except that to the extent the Commission deems such action necessary to the discharge of its responsibilities, personnel may be employed and their compensation fixed without regard to such laws. The Commission shall make adequate provision for administrative review of any determination to dismiss any employee;

(5) acquire such materials, property, equipment, and facilities, establish or construct such buildings and facilities, and modify such buildings and facilities from time to time as it may deem necessary, and construct, acquire, provide, or arrange for such facilities and services (at project sites where such facilities and services are not available) for the housing, health, safety, welfare, and recreation of personnel employed by the Commission as it may deem necessary;

(6) with the consent of the agency concerned, utilize or employ the services or personnel of any Government agency or any State or local government, or voluntary or uncompensated personnel, to perform such functions on its behalf as may appear desirable;

(7) acquire, purchase, lease, and hold real and personal property as agent of and on behalf of the United States and to sell, lease, grant, and dispose of such real and personal property as provided in this *Act; and*

(8) without regard to the provisions of the Surplus Property Act of 1944 or any other law, make such disposition as it may deem desirable of (A) radio-active materials, and (B) any other property the special disposition of which is, in the opinion of the Commission, in the interest of the national security.

(b) SECURITY.—The President may, in advance, exempt any specific action of the Commission in a particular matter from the provisions of law relating to contracts whenever he determines that such action is essential in the interest of the common defense and security.

(c) ADVISORY COMMITTEES.—The members of the General Advisory Committee established pursuant to section 2 (b) and the members of advisory boards established pursuant to subsection (a) (1) of this section may serve as such without regard to the provisions of sections 109 and 113 of the Criminal Code (18 U. S. C., secs. 198 and 203) or section 19 (e) of the Contract Settlement Act of 1944, except insofar as such sections may prohibit any such member from receiving compensation in respect of any particular matter which directly involves the Commission or in which the Commission is directly interested.

COMPENSATION FOR PRIVATE PROPERTY ACQUIRED

SEC. 13. (a) The United States shall make just compensation for any property or interests therein taken or requisitioned pursuant to sections 5 and 11. The Commission shall determine such compensation. If the compensation so determined is unsatisfactory to the person entitled thereto, such person shall be paid 50 per centum of the amount so determined, and shall be entitled to sue the United States in the Court of Claims or in any district court of the United States in the manner provided by sections 24 (20) and 145 of the Judicial Code to recover such further sum as added to said 50 per centum will make up such amount as will be just compensation.

(b) In the exercise of the rights of eminent domain and condemnation, proceedings may be instituted under the Act of August 1, 1888 (U. S. C., title 40, sec. 257), or any other applicable Federal statute. Upon or after the filing of the condemnation petition, immediate possession may be taken and the property may be occupied, used, and improved for the purposes of this Act, notwithstanding any other law. Real property acquired by purchase, donation, or other means of transfer may also be occupied, used, and improved for the purposes of this Act, prior to approval of title by the Attorney General.

JUDICIAL REVIEW AND ADMINISTRATIVE PROCEDURE

SEC. *14. (a) Notwithstanding the provisions of section 12 of the Administrative Procedure Act (Public Law 404, Seventy-ninth Congress, approved June 11, 1946) which provide when such Act shall take effect, section 10 of such Act (relating to judicial review) shall applicable, upon the enactment of this Act, to any agency action un the authority of this Act or by any agency created by or under provisions of this Act.*

(b) Except as provided in subsection (a), no provision of this shall be held to supersede or modify the provisions of the Adminis tive Procedure Act.

(c) As used in this section the terms "agency action" and "age shall have the same meaning as is assigned to such terms in Administrative Procedure Act.

JOINT COMMITTEE ON ATOMIC ENERGY

SEC. *15.* (a) There is hereby estbalished a Joint Committee Atomic Energy to be composed of nine Members of the Senate to appointed by the President of the Senate, and nine Members of House of Representatives to be appointed by the Speaker of the H of Representatives. In each instance not more than five mem shall be members of the same political party.

(b) The joint committee shall make continuing studies of activities of the Atomic Energy Commission and of problems rela to the development, use, and control of atomic energy. The C mission shall keep the joint committee fully and currently info with respect to the Commission's activities. All bills, resolutions, other matters in the Senate or the House of Representatives rela primarily to the Commission or to the development, use, or contr atomic energy shall be referred to the joint committee. The mem of the joint committee who are Members of the Senate shall from to time report to the Senate, and the members of the joint comm who are Members of the House of Representatives shall from tim time report to the House, by bill or otherwise, their recommendat with respect to matters within the jurisdiction of their respective Ho which are (1) referred to the joint committee or (2) otherwise wi the jurisdiction of the joint committee.

(c) Vacancies in the membership of the joint committee shall affect the power of the remaining members to execute the funct of the joint committee, and shall be filled in the same manner a the case of the original selection. The joint committee shall sele chairman and a vice chairman from among its members.

(d) The joint committee, or any duly authorized subcomm thereof, is authorized to hold such hearings, to sit and act at places and times, to require, by subpena or otherwise, the attend of such witnesses and the production of such books, papers, documents, to administer such oaths, to take such testimony, to pro such printing and binding, and to make such expenditures as it d advisable. The cost of stenographic services to report such hea shall not be in excess of 25 cents per hundred words. The provi of sections 102 to 104, inclusive, of the Revised Statutes shall app case of any failure of any witness to comply with a subpena c testify when summoned under authority of this section.

(e) The joint committee is empowered to appoint and fix compensation of such experts, consultants, technicians, and clerical stenographic assistants as it deems necessary and advisable, but compensation so fixed shall not exceed the compensation presc under the Classification Act of 1923, as amended, for comparable d The committee is authorized to utilize the services, information, f ties, and personnel of the departments and establishments of Government.

ENFORCEMENT

SEC. *16.* (a) Whoever willfully violates, attempts to violat conspires to violate, any provision of sections 4 (b), 4 (e), 5 (a) or 6 (b) shall, upon conviction thereof, be punished by a fine o more than $10,000 or by imprisonment for not more than five or both, except that whoever commits such an offense with inte injure the United States or with intent to secure an advantage to foreign nation shall, upon conviction thereof, be punished by *or imprisonment for life (but the penalty of death or imprison for life may be imposed only upon recommendation of the jury only in cases where the offense was committed with intent to i the United States); or by* a fine of not more than $20,000 or by prisonment for not more than twenty years, or both.

(b) Whoever willfully violates, attempts to violate, or cons to violate, any provision of this Act other than those specifie subsection (a) and other than section 10 *(b)*, or of any regulati order prescribed or issued under sections 5 (b) (4), 10 (c), or 1 (2), shall, upon conviction thereof, be punished by a fine of not than $5,000 or by imprisonment for not more than two years, or

ept that whoever commits such an ense with intent to injure the United tes or with intent to secure an adtage to any foreign nation shall, upon viction thereof, be punished by a fine not more than $20,000 or by imprisonnt for not more than twenty years, or h.

c) Whenever in the judgment of the nmission any person has engaged or about to engage in any acts or praces which constitute or will constitute violation of any provision of this Act, any regulation or order issued therever, it may make application to the appriate court for an order enjoining h acts or practices, or for an order orcing compliance with such provision, upon a showing by the Commission t such person has engaged or is about engage in any such acts or practices ermanent or temporary injunction, reaining order, or other order *may* be nted.

d) In case of failure or refusal to y a subpena served upon any person suant to section 12 (a) (3), the dist court for any district in which such son is found or resides or transacts iness, upon application by the Comsion, shall have jurisdiction to issue order requiring such person to appear give testimony or to appear and proe documents, or both, in accordance h the subpena; and any failure to obey h order of the court may be punished such court as a contempt thereof.

PORTS

EC. *17.* The Commission shall submit the Congress, in January and July of h year, a report concerning the activiof the Commission. The Commission ll include in such report, and shall at h other times as it deems desirable mit to the Congress, such recommenions for additional legislation as the nmission deems necessary or desirable.

FINITIONS

EC. *18.* As used in this Act—

a) The term "atomic energy" shall be strued to mean all forms of energy ased in the course of or as a result nuclear fission or nuclear transforma-.

b) The term "Government agency" ns any executive department, commis-, independent establishment, corporawholly or partly owned by the United tes which is an instrumentality of the ted States, board, bureau, division, vice, office, officer, authority, adminision, or other establishment, in the cutive branch of the Government.

c) The term "person" means any indiual, corporation, partnership, firm, asation, trust, estate, public or private institution, group, the United States or any agency thereof, any government other than the United States, any political subdivision of any such government, and any legal successor, representative, agent, or agency of the foregoing, or other entity, but shall not include the Commission or officers or employees of the Commission in the exercise of duly authorized functions.

(d) The term "United States," when used in a geographical sense, includes all Territories and possessions of the United States and the *Canal Zone.*

(e) The term "research and development" means theoretical analysis, exploration, and experimentation, and the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes.

(f) The term "equipment or device utilizing fissionable material or atomic energy" shall be construed to mean any equipment or device capable of making use of fissionable material or peculiarly adapted for making use of atomic energy and any important component part especially designed for such equipment or devices, as determined by the Commission.

(g) The term "facilities for the production of fissionable material" shall be construed to mean any equipment or device capable of such production and any important component part especially designed for such equipment or devices, as determined by the Commission.

APPROPRIATIONS

SEC. *19.* There are hereby authorized to be appropriated such sums as may be necessary and appropriate to carry out the provisions and purposes of this Act. The Acts appropriating such sums may appropriate specified portions thereof to be accounted for upon the certification of the Commission only. Funds appropriated to the Commission shall, if obligated by contract during the fiscal year for which appropriated, remain available for expenditure for four years following the expiration of the fiscal year for which appropriated. After such four-year period, the unexpended balances of appropriations shall be carried to the surplus fund and covered into the Treasury.

SEPARABILITY OF PROVISIONS

SEC. *20.* If any provision of this Act, or the application of such provision to persons or circumstances, is held invalid, the remainder of this Act or the application of such provision to persons or circumstances other than those as to which it is held invalid, shall not be affected thereby.

SECOND ROCKY MOUNTAIN CONFERENCE

The Second Rocky Mountain Conference on Atomic Energy, sponsored by the Social Science Foundation of the University of Denver, was held at Estes Park, Colorado, on June 24-26.

Among the resolutions adopted, were the following:

Resolved that the Conference:

favors the principle of large-scale international exchanges of students, educators, scientists, businessmen, laborers and representatives from other fields of work as an effective means for bettering world understanding and mutual security.

recommends to the scientists to be assembled at the invitation of the British Association of Atomic Scientists, that they develop plans for enlightening the population of the world on the full significance of atomic energy, including both its military and peaceful uses; also that they take steps to form an international association of atomic scientists in all the United Nations.

CORRECTION

In the July 1st issue of the Bulletin we reprinted a brief AP story about the Empire Scientific Conference of the Royal Society of London.

This account, we now learn, is completely misleading. We are indebted to Prof. A. V. Hill, Sec'y of the Royal Society, for calling our attention to the error. Prof. Hill writes:

"The reason for holding the first few meetings of the Empire Scientific Conference in private was simply to allow a frank and free discussion of the scientific organizations and facilities, official and unofficial, in the various countries participating. The delegates could not possibly have discussed the scientific "set-up" in their own and other countries in the same critical, open and friendly way had every remark been liable to publication in the Press, with subsequent misunderstanding and misrepresentation. Anyone who has had any experience of public affairs will know that to have opened those discussions to the general public would have been to make them purely formal and therefore sterile."

"There was never any intention that the scientific proceedings of the Conference should be held in secret, nor were any such proceedings so held. At the President's own suggestion the Conference agreed that after the early intimate discussions on organization the proceedings should be thrown open. The statement that 'The delegates have expressed strong feelings that the situation should never have arisen' is quite untrue. I was present throughout the meetings and never heard any such expression from any delegate."

The Bikini Tests—Radiological Effects . . .

We present below the significant conclusions concerning the Bikini tests given in two reports to Pres. Truman: the first excerpt is from the report of the President's Civilian Evaluation Commission; the second from the report of the Army-Navy Joint Chiefs of Staff.

I

We believe that interesting distinctions between the general results of the two explosions can even now be drawn without the risk of serious error. Both explosions sank several ships. From the limited observation we have thus far been able to make, the ships remaining afloat within the damage area appear to have been more seriously damaged by the aerial explosion than by the submarine explosion. The damage to ships in the first test might have been far greater if the bomb had exploded directly over the target ship, the Nevada.

Radioactivity Compared

In the first test much of the personnel within the ships would have received fatal doses of neutrons and gamma rays from the first deadly flash. On the other hand, the deadly effects of persistent radioactivity would have been much more severe in the second test. Had the target array been manned, it seems clear that casualties and both physical and psychological injury to personnel would have been very great. Rescue and attention to casualties would be difficult and dangerous. Within 2,000 yards of the explosion, ships would probably have been inoperative and a lapse of weeks might well ensue before relatively undamaged ships could again be used in combat.

The second bomb caused a deluge of water loaded with deadly radioactive elements over an area that embraced 90 per cent of the target array. All but a few of the target ships were drenched with radioactive sea water, and all within the zone of evident damage are still unsafe to board. It is estimated that the radioactivity dispersed in the water was the equivalent to that from many hundred tons of radium. Such results might be as disastrous to the fleet as the results of the first test, although in part for different reasons. An enemy possessed of two or more bombs might well so dispose them as to create simultaneously the deadly features of both tests. Such tactics might effectively dispose of a fleet for many months; for example, consider a Pearl Harbor attack on these lines.

Conclusion

As was demonstrated by the terrible havoc wrought at Hiroshima and Nagasaki, the Bikini tests strongly indicate that future wars employing atomic bombs may well destroy nations and change present standards of civilization. To us who have witnessed the devastating effects of these tests, it is evident that if there is to be any security or safety in the world, war must be eliminated as a means of settling differences among nations.

The Civilian Evaluation Commission consisted of Senator Hatch, chairman; Senator Saltonstall; Representatives Holifield and Andrews; Dr. Edward U. Condon, Dr. Karl T. Compton, Bradley Dewey, William S. Newell, and Fred Searls.

II

It is now possible to make some estimate of the radiological injuries which crews would have suffered had they been aboard Test A target vessels. Measurements of radiation intensity and a study of animals exposed in ships show that the initial flash of principal lethal radiations, which are gamma rays and neutrons, would have killed almost all personnel normally stationed aboard the ships centered around the air burst and many others at greater distances . . . It is clear that vessels within a mile of an atomic bomb air burst would eventually become inoperative due to crew casualties.

* * *

In the case of the underwater explosion, the air-burst wave was far less intense and there was no heat wave of significance. Moreover, because of the absorption of neutrons and gamma rays by water, the lethal quality of the first flash of radiation was not of high order. But the second bomb threw large masses of highly radioactive water onto the decks and into the hulls of vessels. These contaminated ships became radioactive stoves and would have burned all living things aboard them with invisible and painless but deadly radiation.

It is too soon to attempt an analysis of all of the implications of the Bikini tests. But it is not too soon to point to the necessity for immediate and intensive research into several unique problems posed by the atomic bomb. The poisoning of large volumes of water presents such a problem. Study must be given to procedures for protecting not only ships' crews but also the populations of cities against such radiological effects as were demonstrated in Bikini Lagoon.

The Army-Navy Joint Chiefs of Staff consisted of K. T. Compton, chairman; L. H. Brereton, B. Dewey, T. F. Ferrell, J. H. Hoover, R. A. Ofstie, J. H. Stillwell.

COMMITTEE FOR FOREIGN CORRESPONDENCE

Through its Committee for Foreign respondence, the Federation of Amer Scientists is undertaking to establish rect contact by mail between scien in this country and those in all part the world.

The Committee, in explaining the pose of the program, states:

"People of other nations, and par larly the scientists, must surely much in the atomic energy policy of United States which is disturbing them. The present lack of mutual ur standing on this question may danger ly strengthen national isolationism time when world peace and security pend upon a rapid extension of inte tional cooperation. Therefore the important part of this correspond program is the sending of published n rial which will reflect the thinking feeling of American scientists. In way we can convince scientists of nations that their colleagues in Am have joined forces to promote inte tional cooperation and that they are termined in particular to avoid an at armament race.

"The mechanism of the correspond is as follows: To every known foreign entist will be sent a personal letter ten at the request of the committee b person who knows the scientist best. personal letter will be accompanied wide selection of non-technical bull statements, and speeches, dealing the social implications of atomic en In addition to such material republ by the Federation, such document "One World or None", The Atomic D opment Report, the Baruch proposal the Russian proposal will also be incl (Issues of the Bulletin which contain documents will be sent by the Commi

"Individuals are urged to give much needed help by: (1) Sending t Committee, preferably on the sta questionnaire form, a list of foreign entists to whom they would be willi write. Questionnaires can be obtain sending a postcard to the Committee Sending to the Committee the name addresses of American friends who foreign scientists. (3) Sending con tions for the support of the Commi work."

The Chairman of the Committee S. Bishop; the treasurer, Oliver Joh Letters should be addressed to Comm for Foreign Correspondence, Box Berkeley, California.

he Road to Security . . . . . . William Higinbotham

can think of no meeting I would rather nd on the anniversary of the Alamo-lo test shot, than this Institute on ld Control of Atomic Energy.[1]

year ago today I attended that other ting—the gathering of scientists and tary men in the New Mexico dawn. all felt very lonely there, very special, remote. With the world what it is human nature what it is, we were id we might be bringing into being es which the world might never master. t is with heartfelt sentiments that I k for my fellow scientists to welcome here.

hat is the basic message of the scien-, which brought us out of our labor-ies and universities, into the political a, which led some of us to become sors to senate committees, to work diplomats in the State Department in the councils of the United Nations? is that the bomb is powerful enough cheap enough to destroy the cities of world. Furthermore, there is no fore-ble defense to stop atomic bombs and ain other weapons of mass destruction eapons which in future wars could in ngle night do as much damage to Eu-'s capitals as was done in six years he last war.

gainst such appalling facts the world s out in wishful thinking for some solution. But we scientists add an-r basic fact to be considered in the lem, and that is that America has no ng monopoly of atomic bomb produc-In four years other powers can have e bombs! Then the average man in street will not be discussing what a b can do to a naval fleet, but what an nic bomb can do to him, and to his e and to **his city.**

E TWO PATHS—WORLD CONTROL NATIONAL DEFENSE

seems to me from this first year of usion, a year in which we hesitated veen one course or another, that Ameri-policy must soon turn decisively down of two roads.

here seem to be only two courses offer-even partial hopes of security for rica in the Atomic Age.

We shall ardently seek and secure a em of world cooperation under law, or We must retreat as a nation into a y of defense and decentralization.

he choice of the scientists is given by fessor Einstein: "Rifle bullets kill men, atomic bombs kill cities. A tank is a nse against a bullet, but there is no nse in science against the weapon ch can destroy civilization. Our defense ot in armaments, nor in science, nor in g underground. Our defense is in law order."

oday, to the word of the atomic scien-has been added the word of many others including military men themselves. According to a story by two well-known writers in the Saturday Evening Post, the experts of the War Department General Staff share this realistic conclusion.

MILITARY MEN SEE NO SECURITY IN ARMAMENTS

Joseph and Stewart Alsop, Washington commentators, write the amazing story of a top War Department board of experts assigned to study the implications of atomic energy. Their final conclusion was summed up in one statement, "The only sure defense of this country is now the political defense." This is one revolution in human thinking already brought about by the irresistible forces of the Atomic Age. The best professional soldiers now admit that adequate armed forces and military preparations, however well-equipped and lavishly financed, can **not** provide security for such a large **and** powerful nation as the United States. **"The only sure defense of this country is now the political defense."**

The War Department Report also discusses the possibility of dispersing our cities, of placing wartime industries underground or in caverns like Mammoth Cave. This Report is not made public. However, there is made public from the White House another War Department report which does discuss these same questions of the road we must take if we do not prove successful upon the road to world cooperation and control.

I think it is sensible realism to discuss now the questions which must be raised if attempts to secure world control fail. Furthermore, I believe this realism will show us that ideas of world cooperation which used to be considered idealism are now the coldest realism.

If we do not have political and technical controls against nations of the world making bombs, we could have the largest **Army**, the largest **air force** and the largest naval fleets in the world and still not protect our cities against atomic attack.

REPORT OF THE STRATEGIC BOMBING SURVEY

This is exactly what is now stated in the official report of the United States Strategic Bombing Survey issued from the White House just two weeks ago. The average man was preoccupied that week end with the termination of OPA or the Bikini test but the study made by the Strategic Bombing Survey of the damage to Hiroshima and Nagasaki may ultimately mean even more to him than the removal or maintenance of price controls.

This Report admits that in any case no defense could prevent appalling damage to our cities, but suggests measures which would permit the nation to continue fighting after that first terrible surprise destruction. To this end, the report speaks of 'dispersal, concealment, protection, and constant readiness of....forces...."

The Report states, "Though a re-shaping and partial dispersal of the national centers of activity are drastic and difficult measures, they represent a social and military ideal toward which very practical steps can be taken once the policy has been laid down."

The Report also suggests that "a national civilian-defense organization can prepare **now** the plans for necessary steps in case of crisis."

These are not the words of an hysterical fear-monger. This is the considered opinion of War Department experts making a survey for the guidance of the Secretary of War and the President of the United States.

Besides the civilian-defense organization, an unheard of proposal for times of peace, the Report continues, "two complementary programs which should be worked out in advance are those for evacuation of unnecessary inhabitants from threatened urban areas, and for rapid erection of adequate shelters for people who must remain."

This prospect of running for cover and burrowing like moles is so fantastic as to seem almost unbelievable. But it has been repeatedly discussed in private and in the **Bulletin of the Atomic Scientists.**[2] It was well brought out in the testimony of scientists before the Senate committee—but last December the public's attention was on the inquiry into Pearl Harbor and not on the prospects of a future Pearl Harbor. Again it must be discussed today as a background to a sincere and impassioned effort to bring the world to an understanding of atomic issues.

Particularly must we appreciate what such mass movements of population would mean to the free American way of life. They could not be accomplished without regimentation and discipline such as Americans have never yet tolerated.

Our defensive frontiers are gone. So, when this Report speaks of evacuation of citizens from "threatened urban areas" they are speaking of **every major city in the United States.** The "threat" will exist and will seem very real when other countries have the bomb—and the consensus of scientists places that time as **about five** years after the publication of the Smyth Report. The last hours of the the first **year** are slipping away. Four years is little

[1] From a speech before the Institute on World Control of Atomic Energy sponsored by the Committee on Atomic Information and held on July 15 and 16 in Washington, D.C.

[2] For instance, "Dispersal of Cities and Industries" by J. Marshak, E. Teller and L. Klein in Bulletin v. 1, No. 9.

time to plan any such civilian evacuations.

There is no sane way of estimating the cost of such a project, for it would mean relocation of industry and disruption of our economy boyond imagination. But we had better begin to evaluate the cost. And our government owes it to its people, having brought this bomb into existence, to make clear just what it means.

ARMS RACE WILL MAGNIFY FEARS

Do our government officials realize the psychological factors involved? One may dismiss as the fears of nervous people those who are now going to fortune tellers—and, according to Newsweek Magazine, asking 'Where can I go to be safe?' Perhaps one may dismiss the opinion of the economist Roger Babson, a man who makes his living out of studying economic trends, who is alarmed about the future of our cities, and actually now recommends investments based on property in rural areas. Perhaps one can dismiss the gloomy potentialities discussed in his newsletter for businessmen, "Atomic Service." But who can dismiss the testimony of General Arnold that the world must give up war? Who can ignore the bill recently introduced in Congress to completely replace the government should its members be destroyed overnight? What diplomat doubts Cordell Hull's statement that peace is now as essential to civilization as air is to individual life? And what military commentator dares to question the cold-blooded recommendation of this latest Report from the White House?

As an atomic scientist I watched the growing fears of scientists through the years of darkness, when the rest of the world did not know of this coming peril. I know that the longer we lived with this problem the more alarmed we become. In this case, familiarity does not breed contempt. It breeds respects

The men who calmly watched the Bikini tests, changed their minds when they came close to the heart of the explosion. As men come ever closer to the heart of this problem they will share the scientists' respect for the atomic bomb. So if our international course continues along the path of an atomic arms race, we shall see a war of nerves such as history does not record. Unless we succeed in establishing world control, government officials must plan defense and decentralization measures beyond description. I have no hesitation in predicting that if they do not, in a few years metropolitan real estate values will topple, as the average man realizes the disadvantages of living in exposed cities in an Atomic Age without world law.

When one considers carefully this dark road to insecurity, the road to international cooperation does not seem so dark and forbidding as before. The basic step is not to start with thinking in terms of international relations in the past. The League of Nations is gone but the world of the League of Nations is also gone. Instead of staring at the end—which is international cooperation and diplomacy, I believe we will be more successful if we start with the problem. Then we do not ask **what can be done** with existing machinery and the traditions and rivalries inherited from the past, from the preatomic era. We must start with atomic energy, and consider, not what would be desirable or easy of achievement or acceptable . . ., we start with the facts, and we follow the facts. In that case, I think we and the other nations of the world will find that their conclusions will consider not what might be done, but **what must be done.** The bomb has caused many controversies. But essentially the issues of atomic energy are the least controversial issues in the world. In the details will be endless conflicts. But they can be worked out if one looks at the clear alternatives with a clear mind.

BATTLE FOR BILL A HEARTENING LESSON

The May-Johnson Bill for control of atomic energy started at the wrong end —not with the beginnings of the problem, but with the circumstances then prevailing. The Senate, however, created a special committee at the suggestion of Senator McMahon, which decided to begin with the atom and devote itself to a thorough study of the problem in order to draft the best possible legislation.

They began with all the competent authorities on the scientific and political implications. They finished with volumes of testimony. Even today the full story of atomic energy is told in this testimony as nowhere else except in the secret archives of the Manhattan District Project. When they reported out the Bill, they sent with it a book which concisely gives the story behind the bill. It is an amazing thing to come from a group of senators. If the scientists have tried to learn something about politics, certainly they must pay great credit to those politicians who have honestly tried to learn something of science.

The McMahon Bill is a good bill, and endorsed by scientists although there are some things in it which we think could be improved. But we are told that judged by legislative standards it is not merely good, it is a miracle. We will have many such miracles as men become familiar with the necessities of our situation.

In the field of world control, the most hopeful single step in the first year was the publication of the Acheson-Lilienthal Report. It is particularly significant because of the way in which the five composing the Lilienthal committe proached their problem. They were men of different backgrounds and perience who had never worked tog before. A government official, a p professor, a chemist, and two ind alists. But they realized from the the importance of the job they had and the revolutionary character o thinking before them. Instead of i diately starting with airing their opi they **decided first to study the s of committees.** They studied the tech of committee work because they th it important to understand why co tees so often fail.

Now today in the United Natio are seeing the clash of personalitie preconceived ideas. But if there i message in our atomic problems wh quite clear, it is that this is a qu beyond old ideas and preconceptio question far above personalities and **above nations.** The staggering com ty of the problem of the State D ment Board of consultants is the pr of the whole world. We shall fail i United Nations if we do not kee minds devoted to the central fact the main issues. But I can not b that the whole world and all the p of the world can not be brought t same conclusions if they are give proper facts to consider.

We are in a revolution even mor reaching than the Industrial Revo of the early nineteenth century, a is not possible to determine polic cording to established political pre nor is it possible to wait and hope a policy will form itself. We do not that much time given to us.

Today the atomic arms race is al well underway. This is officially adı in the report of the State Depar Board of Consultants. And daily newspapers carry stories of yet deadly weapons being brought to p tion, of missiles travelling faster sound, of rockets piercing the s sphere.

International maneuvering to c sources of raw materials for bom hidden from view but we may be that behind the scenes the searc uranium is being carried out on a surpassing that of the Gold Rush c All nations realize there is no subs for uranium.

To scientists, it is plain that the object of the United Nations Atomi ergy Commission must be to sto atomic arms race before it is too Only then will we be able to go solving the other major problems.

But if fear beyond description the world, it will be impossible for ples or nations to act with reason.

he Atomic Bomb and Our Cities . . . .

. . . . from Report of U.S. Strategic Bombing Survey

THE ANGER

e Survey's investigators, as they eeded about their study, found an tent question framing itself in their ls: "What if the target for the bomb been an American city?" True, the ary mission of the Survey was to rtain the facts just summarized. But lusions as to the meaning of those , for citizens of the United States, ed themselves almost inescapably on men who examined thoughtfully the ins of Hiroshima and Nagasaki. These lusions have a different sort of validity the measurable and ponderable facts receding sections, and therefore they presented separately. They are not the important part of this report, how- and they are stated with no less iction.

two cities, whether in Japan or the ed States, are exactly alike. But the ences in terrain, layout and zoning, ty, and type of construction can be ed for one by one; when that is done, arisons become possible. The most ing difference between American Japanese cities is in the residential icts: What happened to typical Jap- homes is not directly applicable to rican residential districts. But in Jap- cities were many brick and wood- e buildings of Western or similar n and of good workmanship. It was opinion of the Survey's engineers, their professional familiarity with ican buildings, that these Japanese ings reacted to the bomb much as al American buildings would have. these buildings were exceedingly vul- le: Multistory brick buildings with bearing walls were destroyed or seri- damaged over an area of 3.6 square at Hiroshima, while similar one- brick buildings were destroyed or usly damaged within an area of six e miles. Wood-frame buildings built dustrial or commercial shops suffered ar damage in an area of over eight , while Japanese residences were oyed or seriously damaged within an of six square miles. That was at hima, where the less powerful bomb used.

ese figures indicate what would hap- to typical wood, brick, and stucco structures in American cities. Modern reinforced concrete and steel-frame buildings would fare better here—as they did in Japan. But the following table shows how American cities are built, and how few are of blast-resistant construction.

TYPES of STRUCTURES by EXTERIOR MATERIAL (U. S. CITIES)

City	Total Structures Reported	Wood	Brick	Stucco	Other No.	%
New York	591,319	236,879	229,482	41,661	13,297	2.2
Washington	156,359	48,971	95,939	5,764	5,685	3.5
Chicago	382,628	131,148	238,959	5,797	6,724	1.7
Detroit	267,677	165,488	94,333	1,923	5,933	2.2
San Francisco	105,180	61,172	2,334	40,902	722	07.

Source: 16th census of U.S. (1940) Vol. II

The overwheming bulk of the buildings in American cities could not stand up against an atomic bomb bursting a mile or a mile and a half from them.

And the people? We must not too readily discount the casualty rate because of the teeming populations of congested Japanese cities. American cities too have their crowded slums, and in addition tend to build vertically so that the density of the population is high in a given area even though each apartment dweller may have more living-space than his Japanese equivalent.

POPULATION DENSITIES U. S. AND JAPANESE CITIES

City	Population	Area Sq. Mi.	Pop. Density per Sq. Mi.
New York	7,492,000	322.8	23,200
Manhattan (day)	3,200,000	22.2	145,000
Manhattan (night)	1,689,000	22.2	76,000
Bronx	1,493,700	41.4	34,000
Brooklyn	2,792,600	80.9	34,200
Queens	1,340,500	121.1	11,000
Staten Island	176,200	57.2	3,000
Washington	663,091	61.4	11,000
Chicago	3,396,808	206.7	16,500
Detroit	1,623,452	137.9	11,750
San Francisco	634,536	44.6	14,250
Hiroshima	340,000 (prewar)	26.5	12,750
center of city	184,000 (1 Aug. 45)	4.0	46,000
Nagasaki	250,000 (prewar)	34	7,000
Built-up area	220,000 (1 Aug. 45)	3.4	65,000

Sources. New York: Fortune, July, 1939—other U.S. cities: 16th census of U.S. (1940)

Most of the population densities in this table are merely averages for people withina city limits. Most meaningful, therefore, are the figures for the central areas of Hiroshima and Nagasaki, and for the boroughs of New York. The casualty rates at Hiroshima and Nagasaki, applied to the mased inhabitants of Manhattan, Brooklyn, and the Bronx, yield a grim conclusion. These casualty rates, it must never be forgotten, result from the first atomic bombs to be used and from bombs burst at considerable distances above the ground. Improved bombs, perhaps detonated more effectively, may well prove still more deadly.

B. WHAT WE CAN DO ABOUT IT

The danger is real—of that, the Survey's findings leave no doubt. Scattered through those findings, at the same time, are the clues to the measures that can be taken to cut down potential losses of lives and property. These measures must be taken or initiated now, if their cost is not to be prohibitive. But if a policy is laid down, well in advance of any crisis, it will enable timely decentralization of industrial and medical facilities, construction or blueprinting of shelers, and preparation for life-saving evacuation programs. The almost unprotected, completely surprised cities of Japan suffered maximum losses from atomic-bomb attack. If we recognize in advance the possible danger and act to forestall it, we shall, at worst, suffer minimum casualties and disruption.

Since modern science can be marshalled for the defense as well as the attack, there is reason to hope that protective weapons and techniques wil be improved. Even protective devices and vigilance, however, cannot be perfect guards against surprise or initial attack, or against the unlimited choices of targets offered an enemy through the range and speed of modern weapons. In our planning for the future, if we are realistic, we will prepare to minimize the destructiveness of such attacks, and so organize the economic and administrative life of the nation that no single or small group of successful attacks can paralyze the national organism.

1. Shelters

The most instructive fact at Nagasaki was the survival, even when near ground zero, of the few hundred people who were properly placed in the tunnel shelters. Carefully built shelters, though unoccupied, stood up well in both cities. Without question, shelters can protect those who get to them against anything but a direct hit. Adequate warning will assure that a maximum number get to shelters.

Analysis of the protection of survivors within a few hundred feet of ground zero shows that even gamma rays can be shielded against. At Hiroshima, for example, persons in a concrete building 3,600 feet from ground zero showed no clinical effects from gamma radiation, but those protected only by wooden buildings at a similar distance suffered from radiation disease. The necessary thickness varies with the substance and with the distance from the point of detonation.

Men arriving at Hiroshima and Nagasaki have been constantly impressed by the shells of reinforced concrete buildings

article is from the fourth and last section Survey's Report. The complete text of the appears in the July 5th issue of "The Unittes News."

still rising above the rubble of brick and stone or the ashes of wooden buildings. In most cases gutted by fire or stripped of partitions and interior trim, these buildings have a double lesson for us. They show, first, that it is possible without excessive expense to erect buildings which will satisfactorily protect their contents at distances of about 2,000 feet or more from a bomb of the types so far employed. Construction of such buildings would be similar to earthquake-resistant construction, which California experience indicates would cost about 10 per cent to 15 per cent more than conventional construction. Even against more powerful bombs or against near misses such construction would diminish damage. Second, the internal damage illustrates the danger from interior details and construction which result in fire or flying debris in otherwise sound buildings. The elimination of combustible interiors and the provision of full-masonry partition walls, fire-resistive stair and elevator enclosures, and fire-division walls would localize fires. Avoidance of glass, tile, or lath and plaster on wood stud would cut down damage from flying debris.

The survival of sheltered sections of Nagasaki suggests forcefully the use that can be made of irregular terrain. Uneven ground reduces the spread and uniformity of blast effect. Terrain features such as rivers and parks afford natural firebreaks and avenues of escape.

2. Decentralization

Hiroshima and Nagasaki were chosen as targets because of their concentration of activities and population. The population density of 45,000 or more per square mile of built-up area explains in part the high casualty rate. Significant, therefore, is the fact that deaths at Nagasaki, despite the greater population density, were only half those at Hiroshima: The difference can be assigned in the main to the separation of the dispersed built-up pockets at Nagasaki, in contrast to the uniform concentration of the inhabitants in the heart of Hiroshima. The Nagasaki bomb thus dissipated much of its energy against hills, water, or unoccupied areas, while the Hiroshima bomb achieved almost optimum effect.

The fate of industries in both cities again illustrates the value of decentralization. All major factories in Hiroshima were on the periphery of the city—and escaped serious damage; at Nagasaki, plants and dockyards at the southern end of the city were nearly intact, but those in the valley where the bomb exploded were seriously damaged. So spread out were the industries in both cities that no single bomb could have been significantly more effective than the two actually dropped.

Medical facilities, crowded into the heart of the city rather than evenly spread through it, were crippled or wiped out by the explosion. Only the previous removal of some stocks of medical supplies from Hiroshima to outlying communities, and the bringing in of aid, enabled the limited medical attention of the first few days.

The similar peril of American cities and the extent to which wise zoning has diminished it differ from city to city. Though a reshaping and partial dispersal of the national centers of activity are drastic and difficult measures, they represent a social and military ideal toward which very practical steps can be taken once the policy has been laid down. In the location of plants, administrative headquarters, and hospitals, particularly, the value of decentralization is obvious, and can be obtained cheaply if the need is foreseen.

Reserve stocks of critical materials and of such products as medical supplies should be kept on hand. This principle of maintaining reserves applies also to the capital equipment of the country. Key producing areas must not be served by a single source of power or channel of transportation. Indispensable materials must not come from processing plants of barely adequate capacity. Production of essential manufactured goods—civilian and military—must not be confined to a few or to geographically centralized plants. And the various regions of the country should be encouraged to approach balanced economic development as closely as it is naturally possible. An enemy viewing our national economy must not find bottlenecks which use of the atomic bomb could choke off to throttle our productive capacity.

3. Civilian Defense

Because the scale of disaster would be certain to overwhelm the locality in which it occurs, mutual assistance organized on a national level is essential. Such national organization is by no means inconsistent with decentralization; indeed, it will be aided by the existence of the maximum number of nearly self-sustaining regions whose joint support it can co-ordinate. In addition, highly trained mobile units skilled in and equipped for fire fighting, rescue work, and clearance and repair should be trained for an emergency which disrupts local organization and exceeds its capability for control.

Most important, a national civilian-defense organization can prepare now the plans for necessary steps in case of crisis. Two complementary programs which should be worked out in advance are those for evacuation of unnecessary inhabitants from threatened urban areas, and for rapid erection of adequate shelters for people who must remain.

4. Active Defense

Protective measures can substa reduce the degree of devastation fr atomic bomb and the rate of casu Yet if the possibility of atomic atta us is accepted, we must accept al fact that no defensive measures alo long protect us. At best they can mi our losses and preserve the funct of the national community throu ital or continuing partial attack. A full and sustained attacks they be ineffectual palliatives.

As defense weapons, atomic bom useful primarily as warnings, as thr retaliation which will restrain a po aggressor from their use as from t of poison gas or biological warfar mission of active defense, as of p defense, is thus to prevent the su use of the atomic bomb from decisive. A wise military establis will make sure—by dispersal, concea protection, and constant readiness forces—that no single blow or se blows from an enemy can cripple its to strike back in the same way or t accompanying attacks from othe ground, or sea forces. The measu enable this unrelaxing state of re are not new; only their urgency creased. Particularly is this true intelligence activities on which in decisions and timely actions depen

The need for research is not lim atomic energy itself, but is equa portant in propellants, detection and other techniques of countering delivering atomic weapons. Also i tive is the testing of the weapo tentialities under varying conditio

Conclusion

One further measure of safety accompany the others. To avoid d tion, the surest way is to avoid wa was the Survey's recommendatio viewing the rubble of German citi it holds equally true whether one bers the ashes of Hiroshima or c the vulnerability of American citie

Our national policy has consisten as one of its basic principles the m ance of peace. Based on our id justice and of peaceful developm our resources, this disinterested po been reinforced by our clear lack thing to gain from war—even in No more forceful arguments fo and for the international machi peace than the sight of the dev of Hiroshima and Nagasaki ha been devised. As the developer ploiter of this ominous weapon, ou has a responsibility, which no A should shirk, to lead in establishi implementing the international gua and controls which will prevent its use.

N Atomic Energy Commission

. . . cont. from p. 12

sarmament Pacts of the Past . . Dr. Van Kleffens

he essence of the Soviet proposal seems be, if I am not mistaken, to prohibit production and use of atomic weapons, hout there being put into force simul- eously an effective system of inter- onal inspection, or of sanctions unless sanctions were approved by the urity Council with an affirmative vote ll the permanent members, a possibil- which to me seems remote. Now the hibition of atomic weapons is, I think are all agreed, entirely sound in ciple. But the question is whether, in r to be effective, that principle should ltaneously be properly implemented system of controls, or whether we can ense with such controls. The Soviet esentative has drawn our attention past cases of prohibition of certain pons. I want to recall that history vs that simple prohibition of weapons, out simultaneous proper implementa- does not look very promising for e who really want to rule out the use tomic weapons.

his method of simply forbidding weap- without more ado has been tried for uries. In the old days, it was considered wful, f.i., to poison wells; nevertheless s are on record in which this unlawful ns of warfare was resorted to.

et me now recall some formal prohibi- s of modern times, consigned in solemn ty form, of various kinds of weapons, let us then see what became of them. First in the series there is the declara- made in the City which then was d St. Petersburg on December 11, , prohibiting projectiles weighing less 400 grams which either are explosive contain incendiary or explosive erial.

e all know what measures of success solemn promise had in aerial and r forms of warfare.

The declaration signed at the first ce Conference at the Hague in 1899 hibiting the use of cartridges which nd in the human body or flatten, the alled dum-dum bullets. As is well wn, it has been charged repeatedly in spite of this declaration such cart- es were used, and there are many s on record in which such cartridges e actually used, not in the sense that e had been issued by the military orities, but in the sense that individual iers had sawed off or cut off the top of lation cartridges in order to increase r harmful effect.

At the same Peace Conference of , many states bound themselves for ears to refrain from throwing pro- iles and explosives from balloons. This declaration was renewed at the second Peace Conference in 1907, but few countries ratified it, the United States and the United Kingdom being the only great powers who did so. Since the declaration was only to be valued if all powers ratified it, its effect was very slight, and we see here again how futile such promises are unless they are backed up by proper implementation and organisation.

4) The regulations on warfare on land adopted by the Hague Peace Conference of 1899 and 1907 issued the prohibition to use poisoned weapons. When we now know about the existence of highly poisonous gases intended for use in war, we can measure how much respect this prohibition inspired.

5) The first Hague Peace Conference also expressly prohibited the use of suffocating or poisonous gases, a prohibition proposed by Russia. We know what came of it. Everywhere there was a total lack of confidence that this frightful means of warfare would not be employed. The effect of the Treaty made at the Washington Disarmament Conference of 1922 forbidding the use of suffocating, toxic or similar gases and other materials, had no effect whatsoever, the treaty being ratified by no one.

I purposely limit myself to acts having the force of an international convention, and leave aside the many attempts to prohibit dangerous weapons which came to nothing. There is one more important matter in this connection, and that is the numerous attempts to prohibit the use of mines in warfare at sea, which, however solemnly proclaimed at the Hague Peace Conferences of 1899 and 1907, never were a success, no more than attempts to prohibit the use of submarines. The attempt made in 1930 at the London Naval Conference to make the observance of certain rules obligatory with regard to using submarines resulted in a treaty, but it had little practical effect.

I think, Mr. Chairman, that I have succeeded in showing that simple prohibitions of the most diverse kinds of weapons have yielded very little, if anything in the way of practical results. I am therefore inclined to think that there is little reason to expect that the mere prohibition of atomic weapons would have better results. Rather do I feel that the contrary is probable, for the simple reason that the atomic weapon has such a vast destructive effect that there will be a strong incentive to nations to run no risk of being annihilated first, and rather use this weapon before some other state does it.

I must therefore conclude that the Russian proposal, although quite sound in principle, needs considerable elaboration if it is to have practical effect, notably in this sense that, precisely because we are concerned here with atomic weapons, we must try to devise a system of international controls, international inspection and effective sanctions, and I believe that such a system is possible on the basis of the American suggestions.

One more point, Mr. Chairman. It seems to me, moreover, that the adoption of international controls and sanctions, provided they are voluntarily accepted, can never be held to be incompatible with the sovereignty of any state. Every state limits its sovereignty everyday by the voluntary conclusion of international conventions, without ceasing to remain, fundamentally, a sovereign state. Sometimes such conventions restrict the unfettered liberty of such sovereign states very considerably, but never is the sovereignty of those states thereby done away with or even impaired in principle.

THE BRITISH ATOMIC SCIENTISTS ASSOCIATION

The atomic scientists of Great Britain formed an organization, called the Atomic Scientists Association, at a meeting held in London on March 8. The members comprise the principal participants in the British Atomic Energy Project.

The officers of the Association are: Prof. Mott, President; Profs. Peierls and Pryce, Executive Vice Presidents; Prof. Moon, General Secretary.

The members of the Council are: Dr. Arrol, Prof. Blackett, Dr. Burhop, Dr. Kurti, Mr. Marley, Prof. Massey, Prof. Mott, Prof. Oliphant, Prof. Peierls, Dr. Pickavance, Dr. Rotblat, Prof. Skinner.

Some of the activities of the Association have been: (a) Preparation of a Memorandum to the UN Atomic Energy Committee (published in **Bulletin** v. 1 No. 12), (b) Critical study of the British Atomic Energy Bill, (c) International Conference on Atomic Energy held at Oxford, July 29-31.

Delegates of the Federation of American Scientists attending the Oxford Conference were Profs. Herbert L. Anderson of the University of Chicago and Henry A. Boorse of Columbia University. A detailed report of the Conference will be published in the **Bulletin**.

A Victory and An Impending Crisis . . . . cont. from p

The atomic scientists are fully in favor of such a procedure. The establishment of an effective international Atomic Development Authority is a promising new approach to world peace and collaboration, a step by which atomic energy can be made a bond between nations instead of a threat estranging them. If it ever be necessary to enforce an atomic disarmament covenant, that would mean that this new approach to peace has failed, and the world has returned to its present status of unlimited national rivalry — whether with or without a legal veto, would make but little difference.

Unfortunately, the attempt to prevent the Atomic Energy Commission from getting entangled in the same type of controversies which have beclouded all the international discussions of the last years, has failed.

Most of the proceedings of the UN commission during July were devoted to the controversy over the relationship of the ADA to the Security Council—a discussion which has produced some interesting thinking on this subject, but has not helped to bring the opponents any closer.

On July 24, after evading a clear statement of attitude on the Baruch plan for over a month, Mr. Gromyko finally rejected it. Though he referred to "US Memorandum No. 3," which dealt with the position of the ADA in relation to other organs of the UN, the tenor of this speech made it clear that it implied the rejection of the ADA—plan as a whole. The French attempt to provide a compromise for the Russians by representing the ADA as a technical body subordinated to the Security Council obviously did not achieve its purpose.

* * *

When asked to present the Russian plan for implementation of the USSR-proposed convention for outlawing the the atomic bomb, he had nothing to contribute except to minimize the importance of control and inspection and to praise the principle of national sovereignty, in his words, "the cornerstone of the San Francisco charter." He insisted that mutual trust and unanimity of the "Big Three" provides the only possible and sufficient guarantee of an atomic disarmament pact.

The actual "making of bombs" is such a minor part of the procedure leading from raw materials to finished bombs, that United States could agree to Gromyko's request to stop assembling bombs and still retain practically all the advantages she has as far as atomic armaments are concerned—advantages which stem first from the possession of large plants producing fissionable materials and second, from the know-how of this production and of the bomb assembly. Whether an American renunciation of the "making of the bombs" —perhaps with a time limit of 6 months or a year—could be used at an appropriate moment as a gesture to create a favorable psychological world reaction is worth consideration; but such a "bomb-making holiday" would not give USSR or the world an iota of real security against atomic warfare.

In brief, Mr. Gromyko cannot be presumed not to know—or to expect others not to know—that the threat of a devastating atomic warfare lies in the unhampered production and accumulation of **atomic** explosives (plutonium and uranium 235) which can be converted into bombs on short order, once an effective design of the bomb is known.

The only way to prevent the threat to peace stemming from the accumulation of atomic explosives, is by placing the **control of all fissionable materials in an international agency**, as suggested in the Baruch plan, or else to **outlaw the fabrication of such mate-ials together with that of bombs.** But the Russians do not wish either of these solutions. They want to retain the right to use atomic energy freely for nonmilitary applications. This means unlimited and uncontrolled production of fissionable materials which are equally needed for bombs and for power plants. Therefore, the Russians cannot logically ask that the US discontinue the operation of U-235 plants at Oak Ridge and the plutonium plant at Hanford, or to refrain from building new plants.

This reduces the convention suggested by the Soviet government to a worthless piece of paper. Such a convention, **if followed strictly by all its signa** (which is more than one dares to h will **not** prevent all nations from acc lating the wherewithal of atomic bo the only hope that bombs will not be if a war breaks out, will then resi the promise of not-doing so.

* * *

THE FIGHT MUST GO ON

The situation created by the unwillingness to enter into the disc of control methods undoubtedly crea danger of a stalemate in the UN A Energy Commission. This deadlock and we believe, can be avoided. The national situation today recalls domestic situation last fall: who have believed then, that nine months a far-reaching program of interna control and cooperative developme atomic energy would be adopted a official policy of the United States g ment?

The deliberations of the UN atom ergy commission must not be allow break down because of one nation's ness in recognizing the revoluti character of the situation and the sity for a bold international solution Soviet government may not be easi cessible to the pressure of public o abroad; but its proclaimed basis belief in scientific diagnosis and app to the solution of social problems. R scientific experts cannot help arrivi the same diagnosis of the situation as American and British colleagues.

Discussion in the scientific and tec sub-committee of the UN Comm which is now under way, will provi opportunity for Russian scientific e to become acquainted with the motiv attitudes of their colleagues. We that through this and other medi political leaders of the USSR will be aware of the vital necessity for a r international solution of the atomic gy problem. With such a solution nized as the common interest of country in the world—theirs as w ours—the Soviet leaders may be les picious of the plans evolved by our tists and political experts. They ma in realizing that these plans were d in an honest desire to free *all* m from the threat of destruction in an war, and not with the selfish int perpetuating the US lead in atomic ments.

Material in this Bulletin is released for publication at 12 noon, Sat., Aug. 10.

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The opinions expressed in the editorials and other articles printed in the Bulletin do not necessarily represent the official views of any organization.

BULLETIN OF THE ATOMIC SCIENTISTS

EDITORS:

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LETIN of the
ATOMIC SCIENTISTS

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ditorial:

nternational Cooperation of Scientists . . .

Slowly, international cooperation in science, disrupted by the r, is being resumed. Conferences are being held, partly on the tiative of old-established international organizations, and rtly under the sponsorship of newly created United Nations lies such as the UNESCO.

Every scientist is whole-heartedly in favor of full cooperation h his fellow-scientists abroad. For a long time after the age Enlightenment, when the international scientific community s first established, this community continued to function even times of war. Governments warred on each other, but Acanies remained at peace. But the growth of nationalism togethwith the development of modern technology has gradually nsformed the limited wars of dynasties into total wars of ire nations. Now, after two world wars, the development of entific methods of warfare has chained science tighter than r to the national state. As a consequence, high walls of secreare being erected, not only between former enemies, but even ween recent allies.

Every international scientfic conference is a welcome event. only do these reunions bring together old friends who rember the brotherhood of science of before 1933—perhaps even ore 1914. What is more important, they bring the tradition science as a unifying force in humanity, to the conscience of a , war-grown generation of scientists. Only by a return to the universal tradition can science escape becoming a handden of national technology—war technology above all. Such utilitarian nationalistic degeneration would not only deprive nce of its moral value as a disinterestsearch for truth, but would deter great ds from entering it and thus write an to the age of scientific discovery.

II

owever much we may welcome the oration of professional cooperation been nations, it is not enough. The atomic b, germ warfare, the world-circling tosphere rockets, will not wait for dual restoration of international trust cooperation. Unless a new departure in rnational relationship is made soon, the well-meant attempts to resume rnational scientific life will come to ght. The apprehension of a catastro- development has caused large groups American scientists to forget their past ofness in politics and to organize for a t to prevent science from becoming an cutioner of mankind. Within a year, fight has brought two successes: The sage of a domestic law of atomic en- , conceived in the spirit of peace, and official adoption by the United States of a program of international control and cooperative development of atomic energy. The American scientists are overwhelmingly behind this program, not because as loyal citizens they support the policy of their government, but because they are convinced that international control offers the only alternative to an armaments race and an atomic war.

III

American scientists may, by themselves, achieve further useful results in the enlightenment of the American people. They may influence US international policy in the field of atomic energy, by stressing the primary importance of this subject in world affairs, and by supporting a patient, sustained effort to bring about understanding among nations.

But what is most needed now, is a broadening and internationalization of the fight for a rational solution of atomic energy problems. We need an international organization of scientists dedicated to this fight.

It must be formed in a truly scientific spirit of search for objective truth, and devoted to service to humanity, transcending national, party or class affiliations; and it can only achieve its purpose if it brings together the most representative scientists of the world.

During the past year, when plans for international control were discussed among American scientists, many anticipated that these plans might appear in a different light to Americans and to sincere friends of America abroad. This was to be expected particularly in the proposed step-by-step procedure of disarmament and release of information. It was felt that, in such case, the initiative for formulating alternative proposals might best be left to representatives of other nations. Some of these divergent views are now coming to light. We believe that a reasonable program for their solution can be worked out in a frank discussion between qualified representatives of world scientists. The realization of this program must be the common goal.

We need international organizations of scientists to attain various worthy objectives: the advancement of scientific knowledge; furthering the welfare of scientific workers; study of social problems of world-wide importance and for dissemination of information on scientific developments of major importance to mankind. But above all this, we need an international community of scientists to develop a positive program of international control of atomic and other weapons of mass destruction, and to lead national groups in a concerted effort for the realization of the program.

E. R.

IN THIS ISSUE

The Bikini Tests and Public Opinion . .

. . . *William L. Lauren*

The following is an article from the New York Times by its distinguished science reporter.

The tumult and the shouting about the Bikini atomic bomb explosions have died down and the time has come for serious thinking about the net results and their implications, national and international.

To evaluate the two tests in Bikini Lagoon it is not enough to determine the effects of the atomic bomb on naval vessels of various types artificially placed at varying distances from the center of the explosion.

Scientists and others closely connected with the development of the bomb, who know its potentialities for wholesale destruction and who devoted their energies during the last year to arouse public awareness of the danger confronting civilization, consider it of vastly greater importance to gauge the effect of the Bikini tests on the change of attitude of the public toward the greatest problem facing mankind today.

Considered from this point of view, the Bikini tests add up to a tragedy of errors for which the world may pay a heavy price unless measures are taken in time to counteract them.

On returning from Bikini, one is amazed to find the profound change in the public attitude toward the problem of the atomic bomb.

Before Bikini the world stood in awe of this new cosmic force which, concentrated in one rather small package, could destroy a large city, kill and maim hundreds of thousands and bring the surrender of an army of 5,000,000 men without the firing of a shot.

Facts Given to Truman

Since Bikini this feeling of awe has largely evaporated and has been supplanted by a sense of relief unrelated to the grim reality of the situation. Having lived with a nightmare for nearly a year, the average citizen is now only too glad to grasp at the flimsiest means that would enable him to regain his peace of mind.

He had expected one bomb to sink the entire Bikini fleet, kill all the animals aboard, make a hole in the bottom of the ocean and create tidal waves that would be felt for thousands of miles. He had even been told that every one participating in the test would die.

Since none of these happened, he is only too eager to conclude that the atomic bomb is, after all, just another weapon. As such it is a problem concerning only the military and nothing for the average citizen to be worried about. Or so the average citizen feels.

How far from reality is such an attitude is revealed by the two reports submitted to President Truman by his two evaluation boards. Nevertheless, it is doubtful that these reports will be sufficient to undo the damage. This factor in itself may far outweigh whatever gains may have been derived from the Bikini tests.

If there is anything the world needs much more than further Bikini tests, it is a reawakening of its consciousness to the fact that the atomic bomb is not just another weapon against which our military minds will find a defense, but the greatest cataclysmic force ever released on earth. Unless some means are found for its control, it will inevitably lead to the destruction of civilization.

Despite the unanimous warnings of the leading scientists who developed the bomb and know its potentialities, this appalling fact had not yet been fully impressed on the minds and hearts of the peoples of the world when the Bikini tests were made. Nor judging by their remarks, had this been fully grasped by the representatives of some of the world's leading nations.

The Bikini tests diverted, at least temporarily, the world's attention from the greatest danger that had ever faced it.

What the reports by the President's evaluation boards did not emphasize is that future wars will employ not atomic bombs singly but by hundreds and thousands.

Dr. J. Robert Oppenheimer, under whose direction the bomb was developed at Los Alamos, N. M., has testified that in the not too distant future atomic bombs will be easy to make and will cost no more than $1,000,000 each. There is enough uranium and thorium in the earth's crust to manufacture them by the thousands, once adequate plants have been built.

While the secret of their manufacture is possessed largely by us, it will take only a relatively short time, five to ten years, before other nations will have it.

The Bikini tests have yielded another lesson of utmost significance to our strategists that is not touched on in the reports to the President. Watching the cloud of death that spread over the Bikini fleet, this observer considered it obvious that phibious invasions such as that in N Africa, Italy and Normandy would be impossible against an enemy posse atomic bombs.

A few atomic bombs exploded in th and under water would not only sin the invasion craft but also kill every aboard them. Those who by miracle escape the blast and heat would surel by the invisible, all-penetrating radi

Had the Germans possessed an a bomb, they would not have had to until the invasion got under way. could have destroyed all England b the invasion could be organized.

Another vital fact must be impress the public mind and on some of the w statesmen who still seem to think an in terms of pre-atomic diplomacy. atomic bomb is not primarily a ta weapon against navies or task f spread out over several miles of ocea the ideal terror weapon, to be used tegically for the wholesale destructi cities, industries and populations.

In the case of an atomic war again United States, an enemy could well to ignore the existence of our Navy a Professor Oppenheimer has testified a rain of atomic bombs could wip 40,000,000 of our population in one

Such an attack would destroy m our vital industrial centers and the tries where the sinews of war are pro including the shells for the Navy's torpedoes, electrical equipment and thousands of items of paraphernalia out which a modern navy could not It would also destroy the harbors to all ships must eventually return, the bases and the naval supply depots.

Deprived of these, ships at sea be left completely helpless after thei plies of ammunition, food and fue been exhausted.

Enemy Gleans Data

Furthermore, the Bikini tests, whil have given us some lessons considere uable, have furnished valuable less a potential enemy. We have revea him, at great expense to ourselves one atomic bomb exploded in the air great harm to superstructures of ships within a half-mile radius" an "no ship within a mile could have es without some damage to itself and s injury to a large number of its cr

We have further revealed to hin unprotected personnel within one m an air-burst atomic bomb would suffe

(Continued on page 17)

How To Keep The Peace . . .
An Analysis and a Proposal . . . . A. P. Lerner

TRODUCTION: A STATEMENT ' THE PROBLEM

No person who is interested in the future human liberty can at the present ment avoid taking a definite stand con- ning the threat of a third world war.

n this memorandum we have tried to w how a maximum of security against r (short of surrender to any aggressor) be obtained with a minimum of change social organization.

This is not because there are no things would like to change. It is because to uire more than is absolutely necessary assure peace is harmful because it sens the chance of the really indispens- e requirements being accepted. On the er hand, to require less than is neces- y diminishes the chance of peace by ing a false sense of security.

We have tried to clarify the main issues well as to propose the solution which ld meet the least resistance. We would sider better than ours any solution of problem which would meet with less stance without losing effectiveness, or ch would be more effective without ountering more resistance. But all the posals we have so far seen are either sufficiently effective or demand things ch, however desirable otherwise, are indispensable for international peace. know well enough how discouraging be the resistances to any effective ce plan. But since to our best under- nding there is no easier way out, it ows that if anything can be done at it will have to be on the lines of our imized requirements.

O POSSIBLE SOLUTIONS

nother world war could be avoided certainty only if all the powers would willing to forego military action in all umstances. There are two instruments ch would increase the likelihood of the ers undertaking to forego military on and keeping their word. One is a eral **Disarmament Agreement** with ad- ate inspection. The other is a system **ollective Security,** i.e. an organization he powers in defense against potential ression by any one of them, command- such an overwhelming array of mil- y strength that the potential aggressor, ng the chances of success negligible, eterred.

Both instruments have their limitations. A disarmament agreement alone may be broken by any nation and then once more war can be avoided only by surrender to the aggressor, involving the acceptance of imposed ideologies, intolerable restrictions of liberties, or wholesale exploitation.

A system of collective security, on the other hand, could be misused and could also break down. Instead of serving to insure a just peace, it might be used oppressively, namely for purposes other than the prevention of aggression. At the same time, defections or disagreements might put an end to its overwhelming power. The collective security organization could also lose its effectiveness if the military strength of the nations loyal to it were to decline in relation to that of an agressor. It must remain both **strong** and **just** if it is to succeed. Collective security prevents war only to the extent that it deters aggressors. If its deterrent effect is insufficient, we are left with an armaments race and eventually war.

For this reason every effort should be made to induce the government of the United States to propose a **disarmament agreement** in the first place and to promote it by every means short of war or surrender.

SOURCES OF RESISTANCE TO DISARMAMENT

Proposals for effective disarmament (with inspection) face three kinds of resistance. These stem from **Tradition, Fear** and **Ambition.**

Tradition: Nations are traditionally reluctant to give up any part of their sovereignty for any reason whatever. Recognition of the threat of an atomic war may help overcome this tradition. It could be further weakened by convincing the individual nations that their independence and freedom would not be threatened, either by individual nations or by international bodies, if they gave up their sovereign rights to the extent necessary for effective disamament.

Fear: Nations are reluctant to weaken their military power out of fear of impairing their relative military position, thus depriving themselves of the possibility of resisting outside pressure and laying themselves open to foreign domination. It is necessary to convince them that general disarmament need not lead to shifts of relative national power, and that the security obtained through it is greater than the protection offered by an arms race.

Ambition: Some governments may pursue a policy of aggrandizement, aiming to conquer part or all of the world for ideological, power, exploitational or other reasons. They may choose war if war is the only way to carry out their policy of aggrandizement.

How can we deal with these sources of resistance to effective disarmament?

The only thing we can do against the tradition of unlimited sovereignty and ambitions for aggrandizement is to influence our own people and our own government not to allow these obstacles to stand in the way of disarmament. Lack of freedom of communication prevents us from exercising the same influence on people in some other countries. Yet if a sincere disarmament proposal is made by us, this may itself have a great effect on other nations.

The principle obstacle we have to overcome is fear—especially each power's fear of giving up armament prematurely, thus becoming a prey to the ambition of other powers. Our first objective must be the fourth of the four freedoms of the Atlantic Charter—**freedom from fear.** The tradition of sovereignty, and even ambition, may to a great extent be interpreted in terms of fear. One of the results of universal fear is the belief that a war for world hegemony is imminent. This is now leading Britain, America and Russia to expand their spheres of influence by every means available, so as to secure a more favorable initial position in the expected war.

A **General Disarmament Agreement** as such would counteract fear and lessen the danger of war breaking out because of fear.

THE NECESSARY FEATURES OF EFFECTIVE DISARMAMENT

The fear of premature relative disarmament can be overcome by proceeding by stages, such that at each stage there is a gain in security corresponding to the armaments sacrificed **without a serious change in the relative power position at any time.** The stages worked out for atomic

energy control in the Lilienthal report form a useful pattern for this kind of procedure.

Insofar as the atomic bomb is concerned, the principles and methods set forth in the Lilienthal report are admirable. But disarmament cannot be wholly effective if limited to only one or a few selected kinds of armament. Such a partial disarmament is likely to affect **relative** power and to increase the fear of those who think themselves relatively weakened. The disarmament agreement must be comprehensive including all weapons not needed for domestic purposes.

The disarmament agreement must cover not only technical disarmament in war weapons but also political disarmament, involving a relaxation of systems of alliances, of spheres of influence, and of such restrictions of freedom within these spheres as are imposed to insure the subservience of the occupied countries. This includes the withdrawal of occupation forces. Such withdrawals, apart from benefitting the occupied countries, would contribute to the removal of causes of conflict. Like other disarmament measures, they should not be directed at changing the relative military position of the powers in terms of potential conflict.

Disarmament should therefore begin with the atomic bomb and should then proceed rapidly, eliminating in two or three years the production of all weapons not needed for domestic use, as well as standing armies, military training and all other economic, psychological and educational war preparations.

THE ROLE OF INSPECTION

An indispensable feature of any satisfactory disarmament agreement is effective inspection to give all nations adequate assurance that no secret armament is being undertaken. The Disarmament Agreement must therefore immediately set up a **Disarmament Inspection Commission.** The Commission is not a decision-making body, hence no voting need take place and the veto question does not arise. The only task of the Commission is to check on compliance with disarmament agreements and to publish its findings. It is not concerned with sanctions. If any power breaks the agreement, the arms race and a possible war may start unless checked by a collective security organization. The Commission exists only to make sure that no power, by secretly breaking the disarmament agreement, can gain a great advantage over an unarmed world.

The Commission should have offices in every country with all the privileges attached to diplomatic agencies. It should have an adequate staff of competent inspectors recruited from all nations, especially from the small neutrals (Sweden, Switzerland, etc.) and nominated by a qualified majority of the nations. The inspectors must have free access and facilities for checking everywhere. Denial of access would constitute a clear violation of the Agreement. The reports, regular and extraordinary, of all inspectors should be published **automatically.** To substantiate the factual correctness of the reports, rechecks and reinspections should be undertaken whenever inspectors report suspicious circumstances or whenever a report issued by an inspector is contradicted.

Furthermore, the inspectors and those who may help inform them should be granted a maximum of independence. The inspectors should be able to protect their informants, and enable them to emigrate.

In general the disarmament should be dissociated from all other domestic and international issues. Its sole objective is to eliminate the danger of war by a mutual renunciation of the means of waging war. Repugnant as any social system may appear to outsiders, attempts to change it by war must be renounced and belligerent as any country's ideology, material preparations and policies may be, military action should be taken only in the case of "clear and present danger." This does not mean that an aggressor must always be given the advantage of choosing the time and place for the first overt attack—but merely that, short of virtual surrender, forcible action should be postponed with careful regard for the possibilities of favorable changes in the suspected nation's government or policy.

COLLECTIVE SECURITY—A CHECK TO POTENTIAL AGGRESSORS

As long as agreement on these lines is observed by all, war is avoided. Such a scheme however may break down. It is necessary therefore to provide for ways to prevent war in case the disarmament agreement breaks down. This implies a collective security agreement.

Under the collective security agreement all nations will pledge themselves to proceed jointly against any of their number who is guilty of violating the Disarmament Agreement or of an act of aggression. Under its present statutes, the United Nations organization cannot put such an agreement into effect because any m[…] possessing the veto can stop action a[…] itself or against any other nation it[…] wish to support. Collective security […] ever means that **collective** military a[…] will be taken against any aggressor.

Simultaneously with proposing the […] armament Agreement, the United S[…] Government should therefore invit[…] nations to join such a collective se[…] organization, or to change the U[…] Nations statutes so that they can […] tively provide collective security.

If the Disarmament Agreement r[…] and effectively abolishes all warlike […] arations, there will be no necessit[…] the collective security organizatio[…] act in any way. But if some co[…] violates the Disarmament Agreemen[…] can be prevented only by surrend[…] by a collective security organizatio[…] sufficient power behind it to ma[…] effective as a deterrent.

If any significant power should […] to participate in the Disarmament A[…] ment, there could of course be no dis[…] ment agreement and peace would d[…] right from the beginning only on th[…] lective security organization. A col[…] security organization can be estab[…] even if it is not universal as long […] signatory powers are strong enou[…] deter potential aggressors.

If we should fail to mobilize the […] cal universality which is necessary f[…] disarmament agreement or even the[…] whelming majority of power wh[…] necessary for collective security, h[…] ity will face a life and death strug[…] which civilization may well be […] destroyed.

The very frightfulness of this c[…] may become a favorable factor in […] ing all nations to agree to disarm[…] If this old decision to disarm is not […] now, we will live in terror and ins[…] and will have to devote ourselves t[…] stant war preparations. But in an […] sphere free of terror, institutions […] peaceful settlement of internationa[…] lems will grow. The more successful […] in building up such institutions, […] constitute the essence of an effectiv[…] world order, the less danger the[…] be of backsliding into an armament […]

One bold decision now can ave[…] doom facing humanity.

vo International Scientific Meetings in England

. . . . *Henry A. Boorse*

I

July 29-31, an international confer- of Atomic Scientists was held at d, England. It was called by the sh) Atomic Scientists Association, ganization the formation of which lescribed in the **Bulletin** (v. 2, nos. 4). In contrast to the British Fed- n of Scientific Workers—with which perates closely—this Association is mass organization of a trade union but consists of a limited group of qualified scientists who have d on British-Canadian, or American c bomb projects and whose interest is ed on the problem of control of c energy.

international physical conference, red by the Physical Society of Lon- and the Cavendish Laboratory at ridge University held July 22-27th mbridge offered an exceptional op- nity to gather together leading sci- s from all over the world to discuss ucial problems posed by the release clear energy. Owing to the crowded am of this meeting, the Atomic ists Association invited those guests Conference interested in this prob- o come to Oxford for a three-day ng immediately following the Cam- Conference. A large and represen- group accepted and participated in llowing program:

ay, July 29

ional Legislation

ernational Control

iscussion open by Prof. H. L. Ander- on (Chicago) and Prof. M. L. Oli- hant (Birmingham)

ay, July 30—10 a.m.-1 p.m.

lications of Atomic Power

iscussion opened by Lord Cherwell

ay, July 30—3 p.m.-6 p.m.

sibility of an International Federa- of Atomic Scientists and the Aims Functions of such a Federation.

iscussion opened by Professor N. F. Iott

esday, July 31—3:15 p.m.-6 p.m.

sing Session and Reception. Speak-

rof. N. F. Mott (Great Britain) Introductory Remarks

rof. R. Peierls (Great Britain) Report on the Conference

f. J. M. Burgers (Holland) and Prof. Kowarski (France) Aspects of the Atomic Energy Problem

Prof. Boorse (U.S.A.) The Federation of American Scientists

Capt. Blackburn, M.P. (Great Britain) Control of Atomic Energy in England

Mr. Lindsay, M.P. (Great Britain) British Atomic Energy Problems

All sessions except the final one were closed to the public and to members of the press. This proved to be a wise precaution since it allowed the utmost freedom of discussion of all subjects except classified information.

LEGISLATIVE SITUATION IN U.S. AND BRITAIN

In the Monday meeting, the history of American legislation (the May-Johnson and the McMahon Bill) and the role of scientists in it was described by Prof. H. L. Anderson. Prof. Peierls presented an analysis of the British Atomic Energy Law. He pointed out that this law has only been passed in the first reading and is still subject to change. It makes no provision for an Atomic Energy Commission and in fact no such commission could have power according to British law, such power residing only in various ministers—in this case in the Minister of Supply. The scientists however, are anxious to have express provision for an advisory board of experts so that the government will be properly advised. The terms of the present bill provide for the government's monopoly of activity in this field, including the possession of raw materials and the supervision of mining. Various activities may however, be carried on under licensing agreements. The government realizes that science in the Universities must be left free and that there must be some scope for industrial activity. As regards secrecy, nothing in the official Secrets Act is to be changed. Any great discovery bearing on the possible security of the nation is to be put at the disposal of the government and not published for the use of "irresponsible" persons. This is quite a new restriction on science and it is difficult to see what the effect of this provision will be.

ATOMIC ENERGY DEVELOPMENT IN EUROPEAN COUNTRIES

Professor Scherrer stated that in **Switzerland** an Atomic Energy Commission has been appointed which acts as an advisory committee to the President. No legislation has been passed as yet, and in regard to secrecy, the Head of the Commission decides what shall and what shall not be published. The Commission already has at its disposal funds which are being used in support of science in the Universities. He mentioned that there were small groups in Swiss engineering firms who were very much interested in atomic energy and were working on the design of a machine to use atomic power.

Professor Perrin reported that an Atomic Energy Commission had been created in **France** about nine months ago. This commission consists of the Prime Minister, a general Administrator, an officer from the military services, and four scientists. The commission has a monopoly on the raw materials, uranium and thorium. There is also an advisory board for administering the government's monopoly on fissionable materials and isotopically-separated materials. Secrecy provisions apply only for those scientists who are working directly in the government service under the control of the Commission; they are not permitted to publish without authorization. There are no secrecy restrictions on publications of scientists working in the French universities.

Professor Clay gave a resume of the present position in **Holland**. He stated that a Committee for Atomic Energy Research had been formed about six months ago for the purpose of investigating applications of nuclear physics. The government has made funds available for the use of this committee up to the amount asked (no figures were given) but emphasized that there was no restriction on research and no stipulations in regard to secrecy as this was against the "free spirit of science." Only those working directly in the military services on applications of nuclear research were so bound. My impression of Clay's attitude, coupled with numerous private talks with other Dutch nations, made me feel that this group perhaps more than any other really wanted a free exchange of information.

Professor Waller next spoke about the situation in **Sweden**. No legislation has yet been drafted by the government but an Atomic Energy Commission was formed the Universities. Although this work is to about six months ago and funds have been granted by the government for work in be carried on without prohibition on publications nevertheless the military establishment is also at work on nuclear research, and publication there will be decided by a staff in the Military Research Institute.

INTERNATIONAL CONTROL

These reports concluded the program on National Legislation and following an in-

Boorse acted as a representative of the an Federation of Scientists and as an r for the Carnegie Endowment for Inter- l Peace at the meetings described in this The report is based, in part, on notes pre- by Prof. R. Peierls and Dr. P. Doty. We lebted to Prof. James T. Shotwell for per- to use portions of Prof. Boorse's report to rnegie Endowment for International Peace.

termission the session went on to consider International Control. Professor Oliphant opened the discussion with a most frank and forceful account of the United Nations Atomic Energy Commission proceedings. He offered an interpretation of the Russian misgivings concerning the Baruch proposals. He felt one should not lose hope that the gap between the two proposals before the A. E. Commission could yet be bridged. He regretted that the British delegation had not attempted to formulate an alternative proposal that might have been more acceptable.

Dr. Kowarski, scientific advisor to the French delegation in the UN Atomic Energy commission, felt that Russian objections to the Baruch plan were more fundamental than mere misgivings and that a compromise on the basis of this plan is therefore a more formidable task than implied by Prof. Oliphant.

APPLICATIONS OF ATOMIC POWER

The Tuesday morning session was opened by Lord Cherwell with an address on the "Applications of Atomic Power". He criticized the exaggerated claims which have been put forward in the British press regarding the benefits to be expected from atomic power. An analysis of the coal production from which most British power is obtained reveals the following: less than 3.5% of the working population is engaged in mining coal and less than 1/20th of the national effort is used in producing power. Of this latter figure, 85% is expended in power distribution. Making due allowance for improvement in distribution, it appears that the total effort that could be saved is 1¼% of the national effort.*

There are special applications where the use of atomic power may present great advantages, such as in warship propulsion, but for national power no advantages can be seen immediately. America may get atomic power soon, but it won't be economic.

The present state of public feeling about atomic power has another harmful side because it has the effect of retarding the effort to mechanize the coal mines and to build dams where suitable for water power.

Lord Cherwell concluded his remarks with the suggestion that a general self-denying ordinance that no large power piles be built for ten or fifteen years would involve no actual hardship. Further, the problem of inspection and control would be greatly simplified.

The discussion of Lord Cherwell's speech was summarized by Prof. Peierls as follows: "The meeting attempted to strike the balance between two extremes, on one hand absurd statements about an Atomic Age in which we would have plenty of power effectively for nothing, and on the other hand the lack of vision that usually meets novel proposals. We all are aware that we are only at the beginning of a development of which nobody can see the end. The importance of Atomic Power rests more in its novel features, in the fact that the weight of the consumed fuel is negligible, rather than in the amount obtainable. As far as we know now atomic power is tied to very special raw materials, which are relatively rare or difficult to extract; economic factors in their utilization are not fully explored and we do not know for example whether it is reasonable to count on enough ever to supply anything like the whole power needs of the world, let alone open up power on a new vast scale. But new discoveries will show new ways, and no scientists would dare predict what will be the position in 20 years from today. For this reason most of us would like to see the power projects pushed vigorously since only in that way can the necessary experience for further developments become available."

INTERNATIONAL ORGANIZATION OF ATOMIC SCIENTISTS

The afternoon session was devoted to a discussion of the possibilities of forming an international federation of atomic scientists and on the aims and functions of such an organization.

Professor Mott opened the discussion by suggesting that an international organization was cumbersome and that national organizations are undoubtedly more effective. However, liaison between these organizations is necessary in order to secure the best results. He hoped that liaison with the Russian scientists would be achieved and that the closest cooperation with the American group would be maintained. One of the functions of the international organization should be to provide for the periodic meeting of the officers of national atomic associations. An international office would also serve for the rapid exchange of vital information as well as for publications and periodicals.

Dr. Burgers expressed the hope that an international body could be formed which would emphasize that nuclear studies should be undertaken only for peaceful ends.

After some discussion it was decided that the main function of the international body at this time would be to facilitate the rapid and accurate exchange of information.

On motion, it was decided to select a representative from each country who would cooperate in finding the proper organi[zation] for carrying out the aims of the [in]ternational bureau. The following pers[ons] were designated:

Professor Boorse—New York
Professor Perrin—Paris
Professor Hylleras—Norway
Professor Bhabha—India
Professor Clay—Amsterdam
Professor Waller—Sweden
Professor Stueckelberg—Switzerland
Professor Pryce—Britain

Prof. Pryce is to act as the tempor[ary] Secretary of the international organi[za]tion. Prof. Pryce has addressed a letter [to] representative organizations of scient[ists] in Argentina, Australia, Belgium, Bra[zil], Canada, China, Czechoslovakia, Denma[rk], Jugoslavia, New Zealand, Poland, Un[ion] of South Africa and the USSR invit[ing] them to designate representatives f[rom] their countries.

A second motion was made, namely [to] explore the location for a suitable in[ter]national office. Professor Boorse [was] asked to explore the possibility of sett[ing] up the offices of the International Inform[a]tion Bureau under the auspices of [the] Federation of American Scientists, pre[fer]ably in New York.

Another suggestion was to contact [Dr.] Joseph Needham, Director of the Divis[ion] of Natural Scientists in UNESCO to [ob]tain help from that organization.

II

"Associations of Scientific Work[ers]" are trade-union type organizations of a[ca]demic and industrial scientists, teach[ers] and related professional workers, wh[ich] have had a considerable success in [the] countries of the British Commonwe[alth] in the last two decades. In Britain, in p[ar]ticular, the British Association of Sc[ien]tific Workers has 16,000 members, [in]cluding many of the most prominent [sci]entists, and has close relations with [the] Labor party. The British group was [re]sponsible for an important step tow[ard] bringing together, after the recent w[ar], the scientists of various countries. It sp[on]sored, in March 1946, the conference [on] "Science and Welfare of Mankind," wh[ich] was attended by Dr. J. A. Simpson [of] the Federation of American Scientists [and] was reported in the Bulletin, v. I, No [3]. The speeches by A. V. Hill, P. M. S. Blackett, and F. Joliot, delivered at [this] conference, were reprinted in the Bulle[tin] v. I, Nos. 7, 8, and 10. At this confere[nce] it was decided to call an internati[onal] meeting of Associations of Scien[tific] Workers in July, to consider the org[ani]zation of a Federation. This meeting [was] held on July 20 and 21, in London. [The] following brief report was prepared [by] Prof. H. A. Boorse, who together with [Dr.] P. Doty, was present as observer for [the] Federation of American Scientists.

* Compare with the more detailed calculations in Prof. Marschak's article in this issue of the Bulletin. Lord Cherwell's address appears in the August 24th issue of "Nature".

A World Federation of Scientific Workers . .

he organization of a world-wide fed-
ion of national Associations of Scien-
Workers, concerned with the respon-
lity of science in promoting human
fare was achieved at the Inauguration
ting held in London on July 20 and 21,
. Delegates and observers from sev-
en nations attended the meeting which
been arranged by the British Associa-
of Scientific Workers. These were:

tralia
r. E. H. S. Burhop, Mr. G. Batchelor

nce
r. Bonet-Maury, Mr. Mathieu

h Africa
iss P. M. Cooke

ada
r. N. Veall, Prof. D. Cass-Beggs

nd
rof. Joseph Obrebski

.
r. Paul Doty (N.Y.), Mr. H. R. Hay
Phila.), Prof. H. A. Boorse (N.Y.),
r. Walter S. Adams (Engineers and
rchitects Assn., Pasadena), Prof. I.
ankuchen (Brooklyn)

ium
r. Max G. E. Cosyns

a
r. Chow, Mr. Tsao

n
r. Duperrier

t Britain
rof. P. M. S. Blackett, Dr. W. A. Woos-
r, Prof. J. D. Bernal, Dr. R. C. Mur-
y, Mr. E. J. Widdowson (Institute of
rofessional Civil Servants), Mr. V.
ott (same)

r. B. C. Guha, Prof. N. M. Saha, Mr.
D. Bhavnami, Mr. P. K. Sanyal

and
rof. L. Rosenfeld, Dr. P. van de Lee-
n, Dr. R. Schmidt, Dr. J. M. Burgers

hoslovakia
r. J. Beran, Dr. Brdicka, Dr. Richter

SCO
r. Joseph Needham, Dr. Yeh Chu-Pei

ter a discussion, the delegates draft-
constitution. An Executive Council
elected to carry out the administrative
until the first Assembly of delegates
member organizations can be held.
offer of the Natural Sciences Division
NESCO to grant the Federation office
e at its new headquarters in Paris
her with secretarial help and prob-
a major part of the salary of the
etary General and expenses of attend-
at Council meetings was accepted.

Professor Blackett (England), as President of the British Association, gave the opening address in which he reviewed the organization of science throughout the world and described how such an organization as contemplated by the Federation might fit into this scheme. Dr. Wooster (England) told the history of the discussions which culminated in this meeting. A delegate from each group or nation then summarized the work of his organization and in most cases expressed the desire that it could be extended and coordinated at an international level. The remainder of the first day and most of the second day was devoted to a point-by-point discussion and revision of the proposed constitution.

The following provisional Executive Council was elected:

President: Prof. F. Joliot (France)

Vice-Presidents: Prof. J. D. Bernal (Great Britain), Prof. N. N. Semenov* (USSR)

Secretaries: M. P. Bonet-Maury (France), Dr. R. C. Murray (Great Britain)

Treasurer: Dr. Harlow Shapley* (USA)

Ordinary Members:
Dr. W. A. Wooster (Great Britain)
Dr. T'sien* (China)

Regional Representatives:
Czechoslovakia & Poland:
Prof. M. A. Belehradek*
British Commonwealth:
Mr. N. Veall
Western Europe:
Prof. L. Rosenfeld
Far East:
Dr. T'U Chang-Wang*
India:
Prof. M. N. Saha
USA & South America:
Dr. P. M. Doty

(*) indicates that consent of this individual has to be obtained.

Two further regional representatives remain to be elected, to represent the Soviet Union and Scandinavia.

It was further agreed that each organization at the conference should elect a corresponding member to receive all information from the Executive Council.

The Executive Council met on July 24 with Professor Joliot in the chair. After general discussion, it was agreed that one committee headed by Dr. Murray would prepare a booklet, for printing and general circulation, containing an introduction by Prof. Joliot, copies of the speeches delivered at the meeting by Prof. Blackett and Dr. Wooster, a summary of the meeting, summary of the constitution and list of officers. Another committee composed of Wooster (Britain), Veall (Canada) and Doty (USA) was instructed to bring the constitution into final form and to write a preamble. When the constitution is approved by the Executive Council it will be circulated to all organizations represented at the meeting for ratification.

In the provisional Constitution it is declared that the aim of the Federation shall be to promote action in the following directions:

a. To work for the fullest utilization of science in promoting peace and the welfare of mankind; to insure that science is used to help solve the urgent problems of the time.
b. To promote international cooperation in science and technology, particularly through close cooperation with UNESCO.
c. To encourage the international exchange of scientific workers and of scientific knowledge.
d. To preserve and encourage the freedom and coordination of scientific work.
e. To encourage improvements in the teaching of the sciences and to spread the knowledge of science and its social implications among the peoples of all countries.
f. To achieve a closer integration between the natural and social sciences.
g. To encourage improvements in the professional, social, and economic status of scientific workers.
h. To encourage scientific workers to take a more active part in public affairs, and to make them more conscious of and more responsive to, the progressive forces within society.

Among the suggestions for future work were the following:

a. Mutual assistance to strengthen existing organizations and to initiate new ones where not yet set up.
b. Formulation of policy on the control and utilization of atomic energy, world food shortage, and the recovery of science in war-devastated countries.
c. Consideration of a code of rights and duties for scientists.
d. Efforts to improve training facilities for science students and technicians and the teaching of science in schools.
e. Investigation of secrecy and the commercial utilization of science.
f. Closer integration of the individual sciences.
g. Science propaganda by films, books and broadcasts.

The Economic Aspects of Atomic Power . . .

. . . . *J. Marschak*

The following was delivered by Professor Marschak before The Second Rocky Mountain Conference on Atomic Energy June 24, 25, 26 at Estes Park, Colorado, sponsored by the Social Science Foundation of the University of Denver. It will appear as a chapter in the forthcoming publication "Power Without War," a review of the proceedings of the conference, which will soon be available at The Social Science Foundation, University of Denver. "Atomic Energy Friend or Foe," a digest of the proceedings of The First Rocky Mountain Conference on Atomic Energy, may now be obtained from the Foundation.

It is important to acquire a correct sense of proportion as to the economic effect of any reduction in the cost of heat and electricity that may be achieved through the use of nuclear fission. Immediately after Hiroshima hopes of the general public soared high: many believed that soon all our work would be done by atomic robots. A few weeks later notes of sobriety were sounded. Some of the best known scientists testified before the McMahon committee that the immediate economic benefits of the new invention may be easily outweighed by its military dangers; so much so that it might be best "to throw into the Mississippi" the fissionable materials already produced. More recently a different and less negative attitude was taken by the Lilienthal committee.

It has "concluded that the beneficial possibilities—some of them are more than possibilities for they are within close reach of actuality—in the use of atomic energy should be and can be made to aid in the development of a reasonably successful system of security." The committee's plan "is in part predicated on that idea." An international Atomic Development Authority should combine policy functions with the creative study and development and even—to an extent—the managerial control of peaceful applications of atomic energy. This would attract high grade personnel and give the international body superior knowledge, vigor, and prestige. Far from being a play with fire, the development of peaceful uses might even prevent the fire. Whether this is so depends on the actual size of the promise held out by the new source of energy.

PROSPECTS—IMMEDIATE AND REMOTE

Of the various forms in which nuclear processes can be used economically, the production of cheap electricity is probably the earliest available; though in the long run it may be easily overshadowed by other applications. Specifically, the direct use of low temperature heat for heating densely populated towns may also soon prove economically feasible; the direct use of high temperature heat of the pile (for example, for melting metals) will, no doubt, be explored and may or may not prove feasible. Probably the most important but the least immediate of all applications are those which will be due to the new knowledge of matter, both dead and living, which scientists hope to acquire by using radioactive tracers, a cheap by-product of the pile. For example: if, helped by these research tools, we learn to imitate the action of green leaves in absorbing the sun's energy, the making and splitting of plutonium may become as obsolete and wasteful a process as the burning of coal.

But this is very remote. For the time being, it is in order to compare the cost of electricity based on fission with the cost of electricity based on the burning of coal (or oil or gas) or derived from the energy of falling water. The essential advantage of the fission process is the very low cost of transportation of atomic fuel (plutonium or light uranium, probably in combination with thorium), per unit of energy produced. The most obvious consumers of fission-based electricity are therefore industries and localities remote from either coal (or oil or gas) or falling water. This includes long voyage ships but excludes (because of the weight of protective shields) light overland vehicles such as automobiles, thus leaving a large part of oil consumption safe from competition.

FUEL FREIGHT AND NATIONAL INCOME

How important is the national effort spent on fuel transportation compared with the total national effort? It is not very important, and therefore the possible economy due to atomic power seems, at the first glance, small indeed. The average wholesale price of coal in the United States was, until recently, about \$5 per ton. Roughly, one half of this price was the cost of mining, another half the cos of transportation and handling. And sinc one pound (1/2000 of ton) of coal make about one kilowatthour of electricity, w say that each coal-based kilowatthou contains about 250/2000=⅛ cent's wort of fuel transportation. This is a smal fraction of the wholesale price of electric ity which may amount to as much as ¾ cents or more. The economy due to th saving of fuel transportation cost is eve smaller if compared with the retail price of electricity paid by the small consume —say, 4 cents per kilowatthour; or com pared, for that matter, with the price o aluminum wares into which electricit enters as an important cost componen but which also contains other costs transportation of raw materials, of semi final and final products, their handling i wholesale or retail trade, and, of cours the production process itself. All thi simply amounts to saying that the trans porting of coal to power plants is a sma part of electricity's cost; that electricit forms only a small part of the tota national product; and that therefore th dropping of coal transportation alone car not make us very much richer than w are or give us much more leisure tha we have already. This can also be seen b taking global figures. We produce eac year 600 million tons of coal, worth, sa 3 billion dollars. If one-half of this sun spent on handling and transporting coa could be saved, and then efforts of rai road men and coal merchants directed int other pursuits, our national income sa 150 billion, would increase by 1%; or i instead, we decided (and succeeded) spread the idleness evenly over all peopl we could start our weekends 24 minut earlier (1% of a 40 hour week). Eve this effect of atomic power might see exaggerated because fissionable materia may not be able to compete with co in all its uses. In fact, power plants bu only about ⅛ of the total coal supply the U.S. Railroads consume about 1/5 American coal and are not easy to electri over long stretches; the steel industr needs coal as a chemical agent as well fuel; in residential heating coal (as we as oil) retains its advantage in less dense populated communities. To be sure, su limitations can be removed by invention say in the shield construction for locom tives or in ore reduction. But, for the in mediate future, the direct increase national income or leisure would be bas on the savings in the transportation fuel for power purposes alone. This woul then mean only one eighth of one p cent of national income or national effo

PRODUCTION COSTS

It has been argued that the economy n fuel transportation may be offset by he high cost of production of atomic fuel. Even its use for power production would n that case, be uneconomical, at least n the territory of the U.S. Since the ission of one pound of plutonium pro-luces roughly 2½ million times more heat han the burning of one pound of coal, it nas been contended that, to be competi-ive, plutonium would have to cost less han 2½ million times the price of coal or, ay, less than $7000 a pound. This is ertainly a small fraction of the actual oer-pound cost of the materials that were contained in the three atomic bombs ex-oloded in 1945. However, this calculation gnores entirely the important by-product of fission of plutonium (or of light urani-um) when it is imbedded in natural urani-um: viz., plutonium itself. According to he Lilienthal report, the primary or "un-afe" plants would produce plutonium and for physical reasons) exactly one-half f the world's supply of nuclear energy. The other half of energy would be pro-luced in "safe" plants; in these no plutoni-um is made. Such plants would, of course, e less economical. As an intermediate ase one can visualize a plant whose fis-ion by-products contain plutonium but which has to ship them away to an "un-afe" plant for purification. Thus half or more of world's nuclear energy would be produced under the following conditions:

input: 1 pound of plutonium + x pounds of natural uranium + labor and materials used in operation and purification + amortization and interest;

output: energy + x pounds of plutonium.

The number x is not published; and ittle experience (published or not pub-ished) can yet exist regarding the cost f purification. The history of chemical engineering makes it almost certain that his cost will soon be brought substantially elow the pioneer Hanford level. If it ecomes sufficiently small and if x is ufficiently larger than unity, then plu-onium can be said to be, in the economic ense, self-replenishing, similar to an in-tallation kept in repair. Only interest and bsolescence—a fraction every year—have o be charged on such an installation in he price of the energy produced. Further-more, the initial cost of this kind of in-vestment would be smaller for plants erected in the future, should the supply of plutonium outstrip the world's demand for energy. As to the installation proper and the operation costs, compared with those af a steam power plant (per kilowatt, and excluding fuel): add, roughly, the cost of health protection, but subtract the furnace and the loss of energy through the chimney. On this basis, atomic energy can probably compete with coal—even in this country of cheap coal—within the decade beginning with 1950; though it will hardly be used near the water power stations.

INTERNATIONAL CONTROL VS. MILITARY SUBSIDY

Political factors may accelerate this development. The Lilienthal report suggests that the "unsafe" plants will be distributed over the world on grounds of political balance rather than according to the cost of energy in various countries. In the case of an atomic armament race, too, countries will make plutonium and energy, regardless of energy need. For countries like ours, with abundant coal or water power this means in both cases subsidizing of atomic energy: citizens pay taxes to buy security. But under the Lilienthal-Baruch scheme the subsidy is smaller (by the value of plutonium exported) and the security is greater (especially for a nation concentrated in large cities) than under a system of atomic armament race.

THE FULL ECONOMIC EFFECT

Our economic estimates were based so far on saving the fuel transportation cost: between ⅛ of a per cent and 1 per cent of national income, depending on whether only stationary power production or also other uses of coal are considered. Should plutonium prove economically self-replenishing, and the installment and operation of the atomic power plants not too different in expense from a steam power plant, one might put zero as an optimistic limit for the atomic fuel cost. The nation's saving would then equal the cost of both mining and transporting coal (and possibly oil used in residential heating), i.e. roughly the double of the previously calculated amount: ¼% to 2% of national income, or weekends starting 5 to 50 minutes earlier than they do now.

This, however is, most probably, not an overestimate. A new invention does not merly displace labor and other resources. It makes possible new combinations. The locomotive and steamboat did not merely displace coachmen, horsebreeders, and sail-makers. Cheap freight rates combined with the cheap soil of new continents and the cheap labor of old have transformed the world. Fuel which involves virtually no freight cost will combine economically with cheap but remote natural resources, with the cargo plane, with the new alloys. Instead of shipping 4 tons of Surinam bauxite to this country to make 1 ton of aluminum, it may be worthwhile to make aluminum in Surinam using atomic power. Cheap aluminum may awaken new demand (for aluminum cars or trains, houses or kitchenware, both here and in China or India) to such an extent that existing American water power plants can continue to operate. Other distant mineral deposits, potential irrigation areas, airfields and harbors will be brought to life and new settlers will demand energy for their homes and trades. If coal freight cost is only ⅛ cent for each kilowatthour generated in this country, it is almost four times as high in the big cities of the South American Atlantic seaboard, and would be ten or twenty times as high in the inland mountains and deserts of that continent or of Asia.

Our own national economy will benefit from the opening up of new areas. They will pay, in cheap materials, for our exports of finished goods, machinery and some farm products, for the services of our capital and of American skilled workers and college graduates. This indirect benefit may quite likely exceed the 2% of national income which we had computed above as the (maximum) effect of replacing American coal by atomic fuel. Probably only the least efficient coal mines will be displaced by atomic power plants installed within our boundaries. Atomic power plants in new areas will create a new demand of those areas for our goods, in addition to the increased domestic and foreign demand for American goods made of cheap materials brought from those areas. Added demand for our goods means added demand for energy produced in this country. Atomic power can thus be introduced into our economy rather smoothly. To use most economically the uranium resources along with the coal and oil reserves, and with the water power of our country and the world, will require cautious comparison of the respective advantages. This will be a function of both the national and the international atomic development bodies.

The Pattern of an Armaments Race

An Anthropological Approach – Part 1 . . . *Gregory Batesc*

The view which an applied scientist—whether he be anthropologist or physicist—takes of the world is determined by two major premises: First that the phenomena with which he deals are so regular that certain forms of prediction are possible. This is a minimum statement of the determinism which is basic to all science, but it is not to be taken or mistaken for fatalism. The second premise in his creed, indeed, expressly rules out fatalism. It states that the deterministic prognosis in any given instance may be profoundly modified by the subject's awareness of the relevant circumstances and by his interpretation of these circumstances. Man is, within certain limits, capable of adaptive acts. That is to say, he is capable of modifying his behavior to deal with the circumstances as he perceives them from moment to moment—these modifications being related to the achievement of various types of goals or to the maintenance of physiological or social "steady states". We believe that more knowledge will give more scope for adaptive behavior and we discard that fatalistic fallacy which allows itself to be hypnotized into inaction by the very logic of its own analyses.

At the present time we may reasonably assume that every important nation has responsible planners—economists and psychologists as well as military men—at work on the problem of how to avoid being beaten in an atomic war, and therefore I shall not here attempt to duplicate their gloomy efforts but shall concentrate upon what can be done towards the elimination of war, with the proviso that, in fact, we need only consider those steps which do not prejudice the plans which aim at avoiding atomic defeat.

Broadly, there appear to be two sorts of relevant change towards which anthropologists might contribute suggestions based upon their particular types of analysis of the circumstances. These are: The retardation of the international armaments race and the diminution of nationalism.

ANALYSIS OF ARMAMENTS RACES.

Here we have to deal with a system of linked causes and effects, and this system is of a type which has been subjected to a great deal of analysis. (See, for example: Richardson, L. F. Generalized Foreign Politics, (British Journal of Psychology Monograph) 1939. Mead, M. et al. Competition and Cooperation Among Primitive Peoples McGraw Hill, 1937. Bateson, G. "Naven", Cambridge Univ. Press, 1936 Chapter XIII.) Broadly the phenomena may be summarized as regenerative (or "vicious") circles of cause and effect, such that A's actions become stimuli for B's actions of the same type, and these in turn become stimuli for further actions by A, and so on. Stated in these very broad terms, clearly every such system might progress at greater and greater speed until it topples over into the state of war. There are, however, a number of other considerations which have to be taken into account:

1. The relation between stimulus and action is complex and is subject to reversals of sign. In Richardson's basic equations it is assumed that A's rate of armament will be proportional to the amount of armament possessed by B. This basic equation he elaborates, examining also the implications of a system in which the effective stimulus would be, not B's total armament but that armament which B has in excess of A. The stimulus factor in the equation in then (B-A), and the rate of A's armament equals (B-A) multiplied by a constant which Richardson calls "the defence coefficient". Such an equation may satisfy those cases in which each side argues "The other side is getting ahead of us. We must therefore hurry up."

This, however, is not the only type of argument which stimulates armament. There is also an argument in which the sign is reversed. "The others are falling behind. Let's get ready to beat them up." In this case, and also in "The others are so far ahead of us that we had better appease them" we see a reversal of sign so that the stimulus factor which will make A arm more rapidly is now, not (B-A) but (A-B), and when this latter term is negative in value, we may even see "negative aggression" in the form of appeasement.

2. It is known that the various cultures of the world differ enormously in the degree to which they are characterized by predominance of one or other of these opposite types of relation between stimulus and aggressive activity. The "bully-coward" motivation is one which is rather sharply disapproved in American and English life, while motivation in terms of the excess of strength held by the opponent is strongly approved in terms of "fair play". In Germany, on the other hand, it is expected as a matter of course that the stronger will take advantage of his extra strength, and that the weaker will submit. In Russia, preliminary studies indic that very high value is set upon achiev one's own full strength. It is not the f that one can beat somebody else tha important but the assurance that on exerting one's full strength. Confli especially conflict against an enemy wh conceived to be stronger than oneself—r help one to this assurance but conflic by no means the only way of achieving

There is thus a vast field, here, for m exact research. It is of the first importa that the policy makers of the world the journalists and peoples should h real knowledge and understanding of th diversities of motivation vis à vis stren Only with such knowledge can they h to retard the armaments race.

3. We must also consider the motiva which each side attributes to the ot Even though each side may be actu motivated in terms of the other's appa extra strength and would actually s down if they thought the others w weaker than they, each will attribute the other the opposite type of motive. E will say "If we don't catch up, the ot will take advantage of our weakness will say to themselves 'let's get ready beat them up'."

4. All the statements in 1. and 2. ab require to be corrected for the fact t the stimulus term in the equations is the real strength but the apparent stren —the strength of the others as it is p ceived or imagined. This figure is sub to two main types of distortion: a. Incre or decrease due to the actual falsifica of the reports and rumors which e arming nation will give to the out world; and here again we shall encou reversals of sign because any given na will sometimes exaggerate and someti minimize the reports of its own stren which it gives to its own people and to world. b. Increase or decrease due ei to persecutional fears or to unreali optimism, and these psychological fac certainly depend upon the cultural co tioning of the individuals concerned, upon their realistic sureness of their personal strength. Such a recurrent m as that of encirclement is no recent velopment in Germany but is a deepse characteristic of German thinking. example, in the German fictional films find, instead of the "chase" so loved Hollywood producers and American a ences, slow encirclements of the hero. human imagination can not only exag ate or minimize the strength of a poten

my, it can also distort the picture of w that strength would be used.

. The matter is further complicated by uliarities of the new weapons. The mic bomb is not only a saturation apon in the sense that when it is used entire defence machinery of the at-ked spot is dislocated. It is also satu-ing in the sense that a given nation d only possess a limited number—a thousands perhaps—of this weapon to ieve "complete" aggressive strength. e making of further thousands will not ther increase its aggressive power. And same considerations apply, on the ole, to the vehicles by which the bombs to be delivered. On the defence side, vever, the picture is very different. en adequacy of defensive preparation is bably impossible. Therefore it appears t we must expect a world in which eral powers are saturated with the apons of attack, but are still making ntic efforts to achieve some degree of iency in defence. The armaments race st then be staged, not as heretofore in enditure of national effort upon weap-of aggression but in enormous ex-ditures upon de-centralization and in-eptive defence.

What will be the psychological impli-ons of this emphasis upon defence? increasing fear of being attacked? An reasing belief that attack is the only ence? Or an increasing realization t war has become an intolerable busi-s? And will every people react alike his peculiar state of affairs? To these stions, the anthropologist can hazard answer only to the last, and to this answer will be "NO." It is most un-ly that the nations will react alike. re will be profound differences between m and these differences will be related *r alia* to each people's special habit esponse to contexts involving strength weakness, attack and defence. Just these differences will be expressed cannot say without further research, we can warn that the nations will ainly misinterpret each other's be-ior and that it is unlikely that these understandings will be of such a kind to promote goodwill between them.

. In addition to the factors which make increased rate of armament among the ions, there is, as Richardson points out, important factor which tends to di-ish this rate, namely the expenditure ch each nation must make to keep up the pace. His equations therefore contain a negative term in which the total strength of the arming nation is multiplied by a "fatigue and expense coefficient." Suppos-ing these equations to be substantially correct at least for moderate disturbances —Richardson has analyzed a series of armaments races and demonstrated sur-prising regularity—we may then follow him in assuming that whether the system will move toward a steady state or toward infinite armament, will depend upon a rather simple relation between the con-stants involved. If we adopt the simpler form of the equations and consider the case of two nations, equilibrium will occur if the product of their "fatigue coeffi-cients" is greater than the product of their "defence coefficients."

In terms of this analysis, the result of the atomic discoveries and other great advances in the machinery of destruction can be stated very simply. It has been to reduce the "fatigue coefficients." A nation can now become infinitely prepared to destroy its neighbors (though not prepared to defend itself) for the modest sum of less than five billion dollars. The likeli-hood that the system will reach equilib-rium in Richardson's sense is therefore very much reduced, though it is conceivable that the nations, having achieved infinite aggressive armament might stand, glaring at each other for an indefinite period without actual war. But the fact that the techniques of rapid attack have so far outstripped those of defence make us doubt whether such a balanced position could be stable. In such a case, it would be too easy for any nation to succumb to the argument, "If we attack, the enemy will immediately become weak. Let us there-fore beat them up," and too easy also, for each side to fear that the other may be on the point of arguing in this way.

SUGGESTIONS FOR RESEARCH AND ACTION

The foregoing, necessarily inadequate and schematic analysis of the mechanism of armaments races suggests lines of ac-tion which might be adopted and which would not prejudice those necessary plans which are designed to prevent any given nation from losing an atomic war:

1. Research. It is evident that full under-standing of the phenomena can only be achieved by detailed studies of the specific psychology of the people and leaders of all the nations concerned. Further, it is evident that such knowledge when ac-cumulated can only take effect if it is disseminated to the thinking and planning people all over the world. There must, at the same time, be sufficient dissemination at a more popular level so that the peo-ples may be a force which will push the planners toward realistic action. It is also very important that such increases in knowledge shall not merely reinforce the fatalistic fallacy, and this danger if clear-ly seen can be avoided.

2. Throughout the above analysis, that frame of mind which is stimulated to aggressive acts by the weakness of the other side appears as the joker. It is bad that nations should compete against each others' strength but infinitely worse that they should switch over to acting aggres-sively in response to another's weakness. The fear that our neighbours may do this is part of the mechanism of the armaments race, and will become of still greater importance when we reach an uneasy bal-ance between several nations all possess-ing atomic arms. It therefore is essential that we determine as precisely as possible which nations are most likely to make this shift in motivation and the conditions under which the shift is most likely to occur. This is a matter about which real-istic precautions may have to be taken but it is also one about which our own unrealistic fears must be kept in rigid control. Beyond this there are possibilities for strengthening the world climate of opinion which already condemns these aggressive acts which are motivated by the weakness of other peoples. And beyond this again, there are dim possibilities for the re-education of those peoples most prone to this type of motivation. Such a re-education would involve very profound shifts in institutional structure and slow modification of the patterns of family life —but without such changes the cultures which promote this type of motivation will continue to be doubly dangerous to the world—themselves likely to attack and continually stimulating other nations to fear that attack may occur.

(To be continued in the next issue.)

The UN Atomic Energy Commission. . .

In the July 1 and August 1 issues of the **Bulletin**, we reported the main stages of the proceedings of the UN Atomic Energy Commission during June and July:

(1) Presentation of the American and Russian plans by Baruch and Gromyko. This was followed by policy declarations by other member nations.

(2) Discussions before "Subcommittee No. 1," which dealt mainly with the Atomic Development Authority and its relation to the Security Council.

(3) Discussions before "Committee No. 2" which soon turned from the American plan to the Russian proposal of a convention outlawing atomic weapons.

CONTINUATION OF DEBATE ON GROMYKO PROPOSAL IN COMMITTEE NO. 2

In the **July 31** meeting, **General McNaughton (Canada)** stressed the difference between atomic bombs and earlier weapons, which make the outlawing of the former impractical without effective control. He pointed out that "in the case of the atomic weapon, the object of a country bent on aggression would be to destroy, by a surprise attack, the very capacity of another country to take retaliatory measures. The effect of the atomic bomb is so crippling that the danger of penalties would not prove a serious impediment to the use of this weapon."

"From Mr. Gromyko's remarks, if I have understood him rightly, he recognizes that the conclusion of the kind of Convention he has proposed must be accompanied by provisions of some safeguards. **I think it would be most helpful in the further discussion in the Committee if we could prevail on Mr. Gromyko at this stage to indicate what measures he has in mind.**"

General McNaughton's plea was supported by **Mr. Harry (Australia)**, who stated:

"The draft convention of Mr. Gromyko is clearly framed on the assumption that a mere solemn declaration by the contracting parties is insufficient—since national legislation to provide penalties for violators is also proposed. National legislation can, of course, be only of a very limited value in preventing **international crimes** against humanity by the use of a weapon which requires **a nation-wide industrial** effort for its manufacture.

"Mr. Gromyko has on several occasions referred to further measures to be adopted, additional to the Convention.

On 19th June, for example, he said:—

"The elaboration and conclusion of a convention of this kind should be followed by other measures aiming at the . . . establishment of a system of control over the observance of the convention and the taking of decisions regarding the sanctions to be applied against the unlawful use of atomic energy."

"**It would be most useful if the Soviet delegate could, at this stage elaborate his proposals so that the Committee may have a clearer picture of their precise intention and implications.**"

"Mr. Gromyko has proposed further that all stocks of atomic energy weapons whether in a finished or unfinished condition should be destroyed.

"It can hardly be Mr. Gromyko's intention that the bombs should be destroyed by explosion. To do so would be to waste a precious and relatively scarce material which might be of tremendous value for the development of power, or for other uses beneficial to humanity. **Yet if, what may be referred to loosely as the "container" or "casing" of the bomb and the detonating mechanism are alone destroyed, the fissionable material which is the essential component would remain, and might, if it came into the hands of a potential aggressor, be used for the construction of atomic weapons within a relatively short period of time.**

"**So even after destruction of existing stocks we would still be face to face with the fact that the peaceful and warlike applications of nuclear fission are closely interwoven . . . and that to ensure that bombs are not made we must ensure that fissionable material is not diverted to such manufacture.**

"In the same way even the obligation not to produce atomic weapons would not affect the right of any nation to stockpile fissionable materials produced in the course of normal industrial processes. In the absence of a system of controls in which all nations could have complete reliance there would be a very powerful incentive to maintain such a stockpile for purposes of national defense.

For these reasons the Australian delegation is most anixous to hear from Mr. Gromyko:—

- **(a) The precise objectives which the Soviet delegation hopes to achieve through the draft convention;**
- **(b) The nature and purposes of the suggested national legislation;**
- **(c) What further measures of supervision and control he envisages?**

In answer to these requests, Mr. Gromyko (USSR) said that:

"**No inspection as such can guarantee peace and security. The idea of inspection of atomic energy is greatly exaggerated in importance. It is a too superficial understanding of the problem of co**

Fundamental control, he asserte "by the co-operation of the Nations." If it was deemed necess discuss in detail what action the S Council would take under certa cumstances, this could be done, h He conceded that past treaties ha violated, but "now there was a ne more solid basis for international re created through organization of the Nations."

Dr. Nervo (Mexico) emphasize measures to **prevent** violations ar important than **punitive** measure **Parodi (France)** called for the Sc and Technical Subcommittee to p practical suggestions for control me and asked for the postponement of p controversies until the report of th committee is forthcoming.

* * *

The **August 6** meeting was opene statement by the Chairman, **Capt.** (Brazil), quoting the Presidential mittee Report on the results of the tests and its conclusions that "the atomic bomb can indeed destroy and change the present standards o ization."

Mr. Hancock (USA) protested sertion of Mr. Gromyko that the U fuses to sign the convention out atomic bombs unless the America trol plan is accepted.

"We are anxious and willing to and have been seeking to have vie sented concerning any modifications provement in the controls which vocate in our plan. In fact, we disappointed if this body cannot i upon these proposals which were d to insure the effective control for our plan was developed."

I had hoped Mr. Gromyko wo us what he had in mind when he r to the Soviet proposal as contem that the UN, and the Security particularly "shall take inter measures . . . action and if necess ternational sanctions as regards vi of the convention." It might be u assume a situation in which, at so in the near future, a nation decide secretly to embark upon agg action, and as a part of that prog begin the secret production of weapons. The queries which arise minds are 1) How the security could learn of it; 2) What the S Council would do if it learned of What steps it could take to be su it had learned in time; and whethe nations would recognize any such

as the kind of safeguards referred to in our orders.

Dr. C. L. Hsia (China) called for patience and said, "In my humble opinion, **if it should take us a whole year to reach agreement on some of the basic issues of the control problem, we would have succeeded beyond all expectation.**"

Dr. Van Kleffens (Holland) said he understood the Soviet proposals to mean that the Security Council should be the organ of the United Nations in charge of control over atomic energy. **He wondered, how exactly, in the thinking of the Soviet delegation, the Security Council would carry out its preventive task.**

Mr. Gromyko (USSR): repeated that "the U. S. delegation says that it is ready to agree that atomic energy should be outlawed as a weapon, but only if we are prepared to accept the U. S. plan."

"Mr. Hancock says that it is the desire of the U. S. government to prevent the possibility, in the future, of any state preparing an act of aggression to make use of the atomic weapon, and with this in view, the U. S. government intends to provide for various measures to insure that such a thing shall not come to pass, and among other measures proposed is that of inspection.

"But at the same time **the United States seems to consider the present situation perfectly normal. A situation in which there is no agreement, no convention, no guarantees forbidding the production and use of atomic weapons. The U. S. seems to regard only the future as of the very greatest importance in this connection but at the same time regards the present situation as perfectly normal. But it is obvious that the present situation is abnormal . . . I don't see how one can ask other states blindly to believe in the good intentions of the United States and to accept the U. S. proposal as regards atomic weapons and at the same time to doubt the good intentions of others.** I do not see how we can at the same time envisage a control of atomic energy and refuse to sign an international convention preventing the production and use of atomic weapons.

"**Dr. Van Kleffens** asks me, how, according to the Soviet plan, the Security Council would carry out its function in enforcing the observance of the convention outlawing atomic weapons. The Charter gives the Security Council wide powers for the maintenance of international peace and security, going even as far as the application of sanctions. Sanctions are classed by the Charter in two categories, first, the rupture of diplomatic relations, the rupture of economic relations, a show of armed force, and second, the application of armed force. The Security Council therefore can take any necessary steps against an aggressor. That includes of course, action by the Security Council against an aggressor using or threatening to use atomic weapons. If it is found necessary to consider in more detail how the Security Council should carry out its functions as regards sanctions against a possible violator of the convention, we can discuss this question both here in Committee 2 and in the Atomic Energy Commission as a whole and we can make our recommendations accordingly.

I have already referred to the two principle lines on which enforcement should be insured. **First, the line of government action: the governments signing the convention would, by national legislation, take steps to insure that the convention is applied and would in particular provide for the most severe punishment. In the second place, the Security Council would guarantee the enforcement of the convention as a part of its duties in connection with the maintenance of international peace and security.**

Dr. Van Kleffens said he was disappointed by the very general nature of Mr. Gromyko's reply. He said that what he wanted to know was: How the Security Council would become aware of such a threat and how it would be able to act in time?

In reply **Mr. Gromyko** said that this question "arises also in connection with the action in general of the Security Council," and not solely in the case of the atomic control.

He declared two courses might be open to the Council: either the Council has in advance a definite system of measures to insure the observance of the convention, or it would need to develop individual methods to treat specific cases of infringement.

Sir Alexander Cadogan (United Kingdom) said that the discussion had turned around the question, whether the Security Council was to be the organ solely entrusted with atomic control. "I doubt whether before further enlightenment from the scientists an answer to this question can be given either way." He suggested that it might be better to wait until the Scientific and Technical Subcommittee had submitted its report.

Mr. Parodi (France) asked Mr. Gromyko what would happen in case a state was suspected of having violated the convention and this state was one of the five permanent members of the Security Council?

Mr. Gromyko in reply said, that he thought his previous speeches had given a clear answer to this question. **"A system of inspection as a means of control is not in conformity with the sovereignty of states."**

As to the particular position of the permanent members of the Security Council, the Soviet proposal provided that the Security Council will act in accordance with the Charter "and this without the least (I wish to underline this, without the least) repercussions as to the rights and privileges of the permanent members or the prerogatives of the Security Council as a whole."

Mr. Hancock asked: How does any part of the United Nations learn of an unlawful act of a nation with atomic war in mind?

Mr. Gromyko replied that he could ask Mr. Hancock the question how the Security Council would know of proposed aggression, regardless of what weapon is going to be used?

After a brief discussion the Committee agreed unanimously not to hold another meeting until the Scientific and Technical Subcommittee had submitted its report.

* * *

The above statement of Gromyko, flatly rejecting the idea of international control and inspection, was perhaps the most disheartening statement heard in the Commission thus far.

SCIENTIFIC AND TECHNICAL SUBCOMMITTEE

The Scientific and Technical Subcommittee, for whose report the Committee No. 2 is waiting in order to resume its deliberations, is under the chairmanship of the distinguished Dutch physicist, Prof. H. A. Kramers. Profs. R. C. Tolman, J. R. Oppenheimer and R. F. Bacher acted as U. S. A. representatives, Prof. D. Skobeltsyn as representative of USSR, Prof. P. Auger represented France and Sir. G. P. Thomson Great Britain.

The Subcommittee met for the first time on July 19. Dr. R. C. Tolman said that the United States favored a resumption of all those methods of scientific interchange that were practiced before World War II: exchange of scientists, research workers, students, scientific cooperation between Academies of Science and other scientific bodies in the different countries, etc.

On the control of the exchange of information, Dr. Tolman made the following two points:

1. The exchange of information in all parts of the Atomic Energy Commission by the representatives of different nations will of course be subject to their national policies as to military security.
2. In cases where representatives on the Atomic Energy Commission need further information from the United States, in order to understand the

(Continued on page 16)

The US Plan for Control of Atomic Energy

. . . . *John Hanco*

I

The January 24 resolution of the General Assembly establishing the Atomic Energy Commission specifically directed the Commission, among other things, to make specific proposals "For control of atomic energy to the extent necessary to ensure its use only for peaceful purposes;" and "For effective safeguards by way of inspection and other means to protect complying States against the hazards of violations and evasions." The resolution did not direct merely the drafting of a treaty in which the nations would only exchange promises.

We have taken these instructions seriously. We know that the problem of the control of atomic energy is the most crucial problem of our time. It is indeed a matter of making a choice between the quick and the dead, between world order and world chaos. The problem cannot be solved by relying on pious hopes, sanctimonious declarations, or professions of international amity and good-will. They will not be enough. This must be a treaty to be kept—a treaty which the world will know is being kept or which the world will know promptly is not being kept so that the violators can be punished immediately.

The plan put forward by the United States is the product of many minds and of many months of realistic thinking. Mr. Baruch and his associates are the grateful heirs of the work that many groups and individuals have put into this problem—scientists, military men, men of industry, members of Congress, the press, the general public and various organized groups such as your own.

I know of no question before us today which is more demanding of the best thought of all of us. We must all think, think again, and rethink about the facts, about the implications that flow from the facts, and about the solutions. This, if ever, is the time for fully informed, painstaking, sound—yet imaginative—thinking. This is no time for torch bearers with uncompromising views on one segment of the problem. And in all this we will seek to understand, to synthesize, to bring together. We all have much to learn from each other, whatever our special field of interest. We must all strive to make our utterances responsible—rational and not emotional—certainly not such as stem from fears or incomplete consideration of the whole problem.

The United States plan, while it may startle those who seek the easy, the conventional, solution, is surely a realistic approach to the hard facts of the problem. It conforms not only to the facts and the needs of the situation but also to the mandate of the General Assembly which specifies a solution based on proposals for controls and effective safeguards.

In brief, the United States has proposed an international authority with unequivocal power to exercise full and effective control over atomic energy from birth to death and a system of swift and certain punishment for violations which shall be stigmatized as international crimes.

II

We do not expect—and we do not want—other nations to accept this plan merely because we are convinced it is a sound one. If any plan of control is to meet the needs of the world, the nations will accept it only if it serves their needs. We do feel, however, that, once the implications of the problem are fully appreciated by all nations which are earnestly and honestly seeking a sound solution, the means of handling this problem, finally arrived at, will necessarily follow the broad lines of the United States plan. So far as I know, every thorough student of the problem finally comes to the same basic conclusion.

We do not expect a quick solution. Even the most diligent and serious concentration on this matter, as has been fully in evidence in the deliberations of the Atomic Energy Commission, cannot evolve a ready answer. All nations must think this thing through—really come to grips with the facts—before they can arrive at a workable solution to which each nation will pledge its best endeavors. No matter how essential speed may be regarded, a sound plan, an effective control with adequate authority, is more essential. Nor is it enough simply to sign a treaty outlawing the bomb. We do not want a treaty covering atomic energy that will have the fate of the Kellogg-Briand pact—to mention only one. Further, it is not enough to set up a system of control such as is envisaged in the American proposal unless the nations will give it full support and subject themselves to an international inspection to prove they are doing so. In recommending an adequate system of control, including unhindered inspection which may be irritating and onerous, we fully recognize that the United States will, over a period of some years, be the primary country subjected to such inspection.

We must have patience and understanding. We must both teach and learn.

Some may say that our plan is too stiff, too novel—so demanding that it is doomed to rejection. Some go even so far as to say it was put forward in such form as to insure its rejection. To this I say it is no stiffer, no more novel, no m demanding than the facts of the prob itself. The United States wants an e tive treaty that will command the sup and respect of the world. That is our objective. Anything less, in our judgm would be a delusion of tragic proporti Any less-than-effective plan for inte tional control of this dread force woul worse than a simple declaration to ou the bomb, for it would arouse false h of security where no security exists.

III

The fundamental instinct of ma self-preservation. The fundamental cern of nations—their primary respons ity—is also self-preservation, and nat have sought it in the concept of abs national sovereignty and national po National power has given a measur security but only up to the point of between what nations unilaterally co er to be their vital interests and as tions. These clashes have come wit creasing frequency, and when they they end only in war.

While in no sense a complete guar of self-preservation, reliance on nati power is, at present, a nation's only choice. It will not and cannot be r quished until a more effective mean assuring self-preservation is found.

The advent of atomic energy has t upon the world the imperative nece of finding a new means of assuring preservation. It also points a way this may be done. It may be the cat that might hopefully bring about a and fruitful relationship of nations peoples. We think that the plan put ward by the United States meets the lenge by making full use of the pos developmental aspects of atomic er on an international basis. Atomic en furnishes not only the challenge but some of the means with which the lenge can be met.

The attitude adopted in developin United States proposal was that it mu a fair-minded plan—fair to us and f all other nations. We would not prop —and I am sure that the American p would not support it—if it were no is a plan of self-preservation, not for selves alone but for the entire world.

IV

But a plan, a treaty, indeed a syste control, is not enough. The Atomic D opment Authority, however skill contrived, cannot work unless it is st with personnel of unquestioned inte and competence. It cannot work unl

The above is an address delivered befo Institute on World Control of Atomic Energy sored by the National Committee on Atomic mation, held on July 15 and 16 in Washington D.

mands respect and confidence through- the world. It must become an entity ly implanted in the minds of men, an itution firmly accepted as an integral t of our world. This will take time. stature will grow only as it reveals by actual performance integrity, impar- ty, and competence. It must develop, ou will, an effective system of inter- onal administrative law built around tive executive functions. It must be ething really new—a world agency executive powers stemming from a ty to which all nations have sub- bed—something never before estab- ed.

y its positive, constructive operations hould attract men of professional com- nce, integrity, and good-will. By its nple, the way may be open to a real munity of nations founded on mutual idence, and patterns of thought and on may be formed which might show way to a successful tackling of the lem of war itself.

is is the vision that may one day e into reality. Is there anyone, any- re in the world, who does not want vision to come to pass?

ut to come back to the present. We t not outpace ourselves. We must e step by step. We must proceed in full knowledge that the vision might , that nations might prove unwilling ove toward world security at the price modicum of pride and position. We ose to conduct negotiations with this ibility in mind. The United States fully recognizes this possibility by iding for a step-by-step establishment the Atomic Development Authority requisite safeguards at every stage. e steps and these safeguards must pecifically defined in the treaty itself.

V

hould like now to comment briefly on in misinterpretations that have aris- oncerning the plan.

rst—the question of the veto. Our osal is this: once nations, by their voluntary sovereign act, have be- parties to a treaty establishing an nic Development Authority and spell- out its functions and setting up cer- acts as international crimes, they be unequivocally bound to abide by undertakings. By this we mean d on pain of severe, swift, and cer- punishment for violations. No nation, g once signed the treaty, can sud- repudiate it and expect to escape shment for its acts of violation. It ssarily follows, therefore, that in this alone—action cannot await a second f unanimity, the first one having oc- d when the treaty was signed. On other hand, up to the point of accept- a treaty, every nation, including the ed States, surrenders nothing, but if it violates its promise once freely given it must not be a judge of its own guilt, and no other nation may be allowed to prevent its punishment.

Within the general framework of the treaty, the ADA must have broad administrative powers. It will carry out policy. It will have to make important decisions and actively operate a large-scale program. It must act. It could not operate if it had to secure unanimous approval of its action from any other organization. The Authority must have power—unequivocal, effective power—commensurate with its responsibilities. What a futile thing it would be to assign such heavy responsibilities to such a body and provide it with less than enough authority to insure the carrying out of its orders.

Exactly how the problem of the unanimity rule of the Security Council can be met in this field, what the precise relationship of the ADA should be to the other organs of the United Nations, particularly to the Security Council, remains to be established. This problem is being given first consideration, and an acceptable solution must be found. The least that must be insisted upon is that (1) once violations of the treaty have occurred, punishment must be swift and certain, and (2) the operations of the ADA cannot be interfered with by the device of the unanimity rule. It would seem desirable, if possible, to accomplish effective control of atomic energy within the framework of the United Nations Charter; but no nation, and none of its nationals, can be permitted, by hiding behind the shield of any provision in the Charter, to claim immunity for wilful violations of a solemn agreement voluntarily entered into, or to prevent the effective operation of the Atomic Development Authority.

Second—the status of the United States plan. The plan put before the United Nations Atomic Energy Commission on June 14 by Mr. Baruch is the proposal of the United States. That is the only official plan. It has the approval of the President of the United States and the Secretary of State. Mr. Baruch is our government's representative in conducting negotiations based on this plan. It is perfectly clear, however, that any treaty that results from these negotiations must and will be subject to the approval of our Congress. And it must be a treaty, for neither the General Assembly nor the Security Council is so constituted as to bring into being such a plan. The United States cannot be bound by any treaty unless and until it is approved in accordance with our established constitutional processes. This is so obvious that I hesitate to mention it. I do so only because it has been implied by some people that we do not seem to recognize this fact. Such people either have not read the United States proposal or are deliberately attempting to mislead, for Mr. Baruch gave his personal word to a Senate committee on this specific point. Also, in presenting the United States plan on June 14th he explicitly stated: "Let me repeat, so as to avoid misunderstanding: My country is ready to make its full contribution toward the end we seek, **subject of course to our constitutional processes** and to an adequate system of control becoming fully effective, as we finally work it out."

Third—exchange of information. The situation on this point is clear. At the opening session of the Atomic Energy Commission Mr. Baruch said: "the United States is prepared to make available the information essential to a reasonable understanding of the proposals which it advocates." Only this and nothing more. The period of negotiation of the treaty is to be sharply distinguished from the series of stages in which the ADA will come into full possession of all information in this field **once the treaty is in full force and effect.** It is in this latter series of stages that we propose making more and more information available to the Authority in step with the progressive establishment of workable safeguards, proven in operation, to protect ourselves and the world from the misuse of such information by any nation. No nation can expect us not to be firm on this point. National security is not going to be impaired while we seek, but have no firm assurance of securing, an effective treaty.

An essential step in the series of stages, yet to be specified in detail in the treaty, would be the undertaking by the United States to dispose of its stock of bombs. This can come only when we and all other nations can be fully assured that no one can turn atomic energy to warlike uses.

VI

We seek security and peace, not for ourselves alone but for all men. We believe there is a way to get this and that that way is delineated in the U.S. proposal. We pledge our best efforts to attempt to secure its acceptance by other nations. With patience, understanding, and knowledge of the facts, we must hope that all nations will come to be convinced as we are convinced that this proposal in its general objectives offers "the last, best hope of earth". We refuse to consider now what we shall do if we fail.

A sound solution to this problem does not insure solutions to the many other problems that beset nations. Their solutions, too, require patience and understanding. But if we fail in this one most critical problem of our time other problems become mere details in a doomed world.

Bill Permits Use of Surplus Sales For International Exchange of Students

From a statement by Assistant Secretary of State Benton.

A step of great long-range significance for the advancement of international understanding was taken when the President signed an act of Congress, introduced by Senator Fulbright of Arkansas, which authorizes the Department of State to use some of the proceeds from surplus-property sales abroad for exchanges of students and other educational activities.

The bill provides that up to $20,000,000 can be earmarked for educational exchanges with any country which buys surplus property and up to $1,000,000 can be spent each year in each country where such an agreement is made. Thus tens of millions of dollars should become available under this bill, over a period of years.

The exchange of students and scholars is, in my judgment, the surest single method, over the decades, for promoting understanding among peoples. The activities of the press, radio, and films are indispensable in the exchange of current information among countries; but the effect of current development is often ephemeral, and news is often misunderstood for lack of background and context. The solid background acquired by those who study outside of their own countries can provide the basis for truer understanding of other peoples. The beneficent results of the Boxer Indemnity scholarships, in the relationship between the United States and China, provides one of the best examples of this.

The Department of State had already completed an agreement with Great Britain, pending congressional approval, which will provide $20,000,000 from the sale of surplus property for educational exchanges with the United Kingdom and the British colonies. Similar agreements are now being negotiated for amounts ranging from $3,000,000 to $20,000,000 in the following countries, among others: Australia, New Zealand, China, the Philippines, Burma, India, Iran, Iraq, Saudi Arabia, Turkey, Egypt, Greece, Italy, Austria, France, Holland, Belgium, and the Scandinavian countries.

The Fulbright bill authorizes the following types of educational activities:

(1) American students can be given grants of foreign currencies to be used to pay the cost of higher education or research in foreign countries.

(2) American professors can be given grants to give lectures in foreign institutions of higher learning.

(3) Foreign students can be given scholarships to study at American non-denominational institutions abroad such as the American University at Beirut, Syria, and Robert College at Istanbul, Turkey.

(4) Foreign students can be given funds to pay for their transportation to the United States to attend American institutions of higher learning.

It is implicit in the bill that all of these activities must be financed with foreign currencies. The bill therefore cannot authorize expenses of foreign students within the United States. The bill is designed to utilize foreign credits in many countries in lieu of American dollars for American surplus property.

The students who will benefit by this bill will be selected by a ten-man Board of Foreign Scholarships, which the bill authorizes the President to establish. The bill provides that this Board shall include representatives of the United States Office of Education, the United States Veterans Administration, state educational institutions, and privately endowed institutions. If funds are negotiated to the limit of the bill's potential, and if facilities abroad develop capable of handling the students, it is possible that 100,000 or more American students would be sent abroad under this bill in the next two or three decades.

Veterans of World War I and II will be given preference. The bill requires that "due consideration shall be given to applicants from all geographical areas of the United States." It is expected that some type of regional selection method will be devised to insure that all parts of the United States are suitably represented.

It is unlikely that any scholarships will be awarded under the authority of this act for the 1946-47 academic year. After the President has appointed the Scholarship Board, and the Board has determined the qualifications for awards, ample publicity and time should be permitted for all suitably qualified people to make application. It is hoped that the grants will be made in the spring of 1947 for the school year beginning in the autumn of 1947.

While the major effect of the Fulbright bill will be to permit thousands of American students to study abroad, we should be prepared to welcome thousands of foreign students to our shores.

The UN Atomic Energy Commission—Continued

(from page 13)

reasons for the provisions pr for inclusion in the charter of ternational authority, they sho quest such information fro United States representative, statement of the reasons wh further information is necess the purpose.

Mr. Gromyko stated that his pr for the exchange of scientific info as put before the Atomic Energy C sion at its second meeting, were in in conflict with the views of the States. "Nobody," said Mr. Gromy asking for secrets."

The subsequent meetings of th committee were held in private a short bulletins were released to th On August 2 Dr. Kramers p that the Committee work towards in conformity with a request made mittee 2 for information on the p of control.

The projected outline for the re cluded such headings as:

1. A qualitative discussion, on scription of the problem;
2. The "order of magnitude", i the nature of the processes of atomic energy, power, radiat atomic energy as a military tion—estimated within the li published information;
3. Analysis of the elements of " —that is, dangerous as distin from safe use;
4. Legal processes—that is, au processes in any plan;
5. Illegal, or clandestine proces
6. Operations not now known to sible (that is, the possibility developments in the atomic field); and a summary and, i sary, conclusions.

* * *

On August 7, it was suggested t report be ready for submission mittee No. 2 by 22 or 23 of Augus has not been submitted by Septem

From the little which has been on the content of the Report, one expect that it will offer solution fundamental political difficulties tered in the work of the Atomic Commission. It will nevertheless b portance if unanimity of all experts—including those represen USSR—can be achieved in, at le formulation of the technical requi of a control system to ensure tha energy will not be used for milit poses.

F. AUGER ON . CONTROL PLAN

d myself in a rather difficult position ; to tell you about how others look , because I do not exactly consider one of the others, having been in untry for a number of years includme of the most trying years of the nd having been fortunate enough to e to collaborate in your atomic bomb t. So I shall try to speak more like speaking to one of his best friends ying to tell him how the others are g at him.

re is a reservoir of admiration where in the world for the United . You are looked upon, as the most ful people, possessiong the most ful scientific and technical achieve- of the world.

re is perhaps not one other country would have had in its possession such erful and unique weapon as the bomb for a whole year without haved it either physically or as a means tical pressure, so that I may say that e looked upon as a very peace-loving . Everyone knows how difficult it is nation like yours, a truly democratic , to go into war except as a defensive re.

her, you have presented a plan in a very large amount of excellent t has been crystallized. This plan es us with a workable solution to the ms of atomic energy. One of the es of this plan is the renunciation, the enunciation, of the use of atomic ens a weapon, which is just now your litary weapon. So this plan is looked s an excellent price of statesmanship a really sincere contribution toward peace. The plan is essentially gen- I think, but you don't see that imely. It is a very serious attempt to ace, peace for the United States and rest of the world.

it would be excellent to add to that a gesture of sheer generosity. It clear up the atmosphere, and further nited States plan. I would not dare gest the gesture that should be made, could be, for instance, to stop asng atomic bombs, or to make availp-to-date scientific information, not ed information, but information of l interest to the scientists of the

ther thing is the distinction between mic weapons and others. The atomic s a weapon, a more terrible weapon ne others because it kills more people time, but in spite of that it is a n just like the others. So that asking aw the atomic weapon alone, and not aw at the same time the mass bomb rdments for instance has, in my opin- meaning at all.

POWER COSTS REPORTED TO UN COMMISSION

A report on the economics of atomic power plants, prepared by a scientific group under the supervision of Dr. Charles A. Thomas, vice president of Montsanto Chemical Company, has been presented to the UN atomic energy commission. A full account of the report will probably be published in the next issue of the Bulletin. *Below we give excerpts from newspaper accounts.*

A nuclear power plan with a capacity output of 75,000 kilowatts probably could be built and fully equipped for 25 million dollars in a normal locality in the eastern United States.

The normal operating cost at capacity would be approximately 0.8 cent per kilowatt hour as compared with a coal power plant which could be set up for 10 million dollars under the same conditions and operate at a cost of 0.65 cent per kilowatt hour.

Advantages of the nuclear plant as weighed against the cheaper production of power from coal under present conditions would include the output of by-product radioactive isotopes for use in analytical work and medical treatment.

The nuclear plant would yield certain advantages also over hydro-electric power plants in being able to supply heating and process steam directly in addition to producing power.

"The nuclear plant might aid in the industrial development of isolated parts of the world where the cost of oil, gas or coal is prohibitive and where a suitable supply of water is unavailable, because the nuclear power plant, if combined with the modern gas turbine, would make unnecessary a supply of any such fuels or cooling water."

"The operating temperature would be high enough to supply power, and...all the plutonium formed would be recovered for later consumption in the pile. No attempt would be made to produce plutonium for use elsewhere."

The present disadvantage of the nuclear power plant in comparison with coal power production would depend only upon the low price of coal.

"Equality of operating costs between coal power plants and nuclear power plants would be reached if the coal cost $10 per ton. It must be realized that lower costs of nuclear power plants can best be achieved by continued research and development.

"Nuclear power plants would make feasible a greater decentralization of industry, a desirable factor in the world economy. Only a trivial amount of fuel need be brought in, and the need for a large cooling water supply might be obviated by the development of gas turbines."

WILLIAM L. LAURENCE ON THE BIKINI TESTS

(Continued from page 2)

casualties by intense neutron and gamma radiation as well as by blast and heat, whereas the under-water explosion could sink a battleship well over 500 feet away, an aircraft carrier more than 1,000 feet away and another battleship about 1,500 feet away. (The distances of the last two are conservative estimates based on personal observation. Foreign naval observers no doubt made more accurate estimates.)

We have, moreover, informed him that in addition to doing great damage to hulls, the under-water explosion threw about 10,000,000 tons of highly radioactive water on the decks and into the hulls of vessels so that "the contaminated ships became radioactive stoves" that "would have burned all living things aboard them with invisible and painless but deadly radiation."

With this information as a blueprint, an enemy would thus know how to use atomic bombs against a fleet in a harbor. He would know just how many bombs he would need and how to space them to destroy the harbor and the ships and all living things aboard them.

It must also be remembered that it is not likely that atomic bombs would be dropped from an airplane at high altitude or be surreptitiously planted below the surface. The development of the V-2 rocket makes it more probable that before long the long-range guided missile, hurtling at 5,000 miles an hour at altitudes of several miles, would be the choice method of dealing swift death to cities and populations.

These are the sober facts that the peoples and statesmen of the world must keep constantly in their minds. They must learn to heed the scientists' warning that no defense against the atomic bomb is possible other than the elimination of war and the effective international control of atomic weapons.

"It is the belief of many of the scientists and engineers connected with this work that a comparatively small standardized nuclear power plant will be developed. If this reasonable prediction comes to pass, such power plants can be placed at strategic points on all established utility company systems. They would greatly reduce power transmission costs and insure partial operation if the system were inoperative."

However, this "would of course complicate any inspection system."

The Atomic Energy Act: An Analysis . . . . *Edward H. L*

The Atomic Energy Act of 1946 is now law. The scope of this legislation may be seen from the following propositions:

1. The disclosure of information relating to atomic energy having no military significance but of industrial importance may be a crime punishable by a fine of not more than $20,000 or imprisonment for not more than twenty years;

2. The Atomic Energy Commission may seize and take over, through condemnation proceedings, any real property containing deposits of uranium or thorium, and with the consent of the President it may seize and take over, through condemnation proceedings, any real property containing any other material determined by the Commission to be peculiarly essential to the production of fissionable materials;

3. After the Act has been in operation, a research worker may not gain access to data relating to the production or use of fissionable material until his character, associations and loyalty shall have been investigated by the Federal Bureau of Investigation and the Commission shall have determined that his access to the data will not endanger the common defense or security;

4. It may be a crime for any American company to have a foreign affiliate, as for example in England, engage in the production of fissionable material;

5. No military or industrial arrangement can permit the distribution of fissionable material to any foreign country unless there is a treaty to that effect approved by the Senate or an international agreement hereafter approved by the Congress;

6. A scientist of competence and an American citizen may be unable to procure fissionable materials for research work because the Commission believes that the distribution to him would be inimical to the common defense and security;

7. The Commission may determine whether a private patent shall be permitted covering the utilization of atomic energy for non-military purposes;

8. The use of atomic energy for non-military purposes, other than research or developmental work, is subject to the licensing authority of the Commission and any license given will be revocable by the Commission at any time;

9. No uranium removed from its place of deposit may be transferred to any person unless authorized by the Commission either through a license or a general ruling of the Commission.

10. Private possession of fissionable material and private operation of government facilities for the production of fissionable material in an amount adequate to produce an atomic bomb are within the discretion of the Commission.

* * *

These propositions do not serve to discredit the legislation which has been passed. They merely emphasize the difficult problems inherent in such legislation and the consequent broad discretion and power given to the Atomic Energy Commission. Few governmental appointments will be of more significance than those to the Commission.

The legislation establishes a five man civilian Atomic Energy Commission which will own all of the fissionable material in the United States and will control the transfer of all source material after it has been removed from its place of deposit. "Fissionable material" is defined to mean plutonium, enriched uranium, and "any other material which the Commisssion determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, or any material artificially enriched by any of the foregoing; but does not include source materials". "Source material" is defined to mean uranium, thorium "or any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable materials." The control over fissionable and source material automatically gives to the Commission complete domination over atomic energy development in this country.

* * *

An obvious attempt was made by the framers of the legislation to achieve a delicate balance between the need for control and the desire to preserve a maximum amount of freedom for the scientists, commercial enterprise and the ordinary citizen. The legislation thus represents a series of compromises. And in most instances where freedom consistent with the necessary control was possible, that freedom has been preserved. Even so, the governmental powers which have been granted are extreme. This is the first legislation to reflect the enormous demands which domestic legislation will have to make in an atomic and divided world.

A compromise was achieved on the military-civilian issue. The members of the five-man civilian board, without special enabling legislation in the future, cannot be active members of the armed forces. They can be retired officers. For the military part of the compromise, a Military Liaison Committee has been created by the legislation. This will consist of representatives of the Departments of War and Navy, assigned by the Secretaries of War and Navy. The Liaison Committee
have consultative powers, but in addi
if the Committee concludes that any a
or failure to act of the Atomic En
Commission is adverse to the respons
ties of the War or Navy Departm
the matter is to be referred to the S
tary of War and Navy and if either
curs in the view of the Committee,
matter then goes to the President fo
final decision. To this extent the legisl
formalizes what undoubtedly would
been the case in any event, but in its
malization of accepted practice and leg
tion has undoubtedly given added pre
to the position of the army and
liaison officers. For example, the cons
tion between the civilian Commission
the military Committee covers all at
energy matters which the military
mittee (not the civilian Commis
deems to relate to military applicat
Additional position is given to the
itary in that the director of the Div
of Military Application within the
mission and appointed by the Comm
sion must be a member of the armed fo

* * *

A compromise was achieved on the
lem of government ownership of mate
useful in the development of atomic en
Here the distinction between fissio
material, as matter capable of rele
substantial quantities of energy thr
nuclear chain reaction, and source
terial, as matter essential to the pr
tion of fissionable material, has serv
cut down the automatic ownership
to the Commission. But while unde
legislation, the Commission is not
automatic ownership of source mat
and it is clear from the intent of
legislation that it is hoped that the
mission will not require such owne
the power to achieve such owne
through condemnation proceedings
been explicitly granted.

The intent of the legislation appea
be to require the Commission to mak
sionable material which it owns avai
for private research and developm
work. This may be done with or wi
charge and the Commission is directe
distribute sufficient fissionable materi
permit the conduct of widespread
pendent research and development
ity, to the maximum extent practica
The Commission is authorized to
"arrangements (including contracts, a
ments, and loans) for the conduct o
search and development activities".
arrangements are to contain provi
to "protect health, to minimize da
from explosions and other hazards t
or property, and to require the repo
and to permit the inspection of work

ned thereunder". It is explicitly pro-
d, however, that the arrangement
ns "shall not contain any provisions or
litions which prevent the dissemina-
of scientific or technical information,
ept to the extent such dissemination is
ibited by law". No such explicit limi-
n is placed upon the conditions which
Commission may exact as part of its
s or regulations governing the con-
of recipients of distributed fission-
material, although it should be urged
this is the intention of the legislation.

eyond this it is to be noted that the
mission is ordered not to distribute
onable material to any person "if, in
opinion of the Commission, the
ance of a license to such person....
ld be inimical to the common defense
security", and no arrangement is to
nade unless the person with whom such
ngement is made "agrees in writing
o permit any individual to have access
estricted data until the Federal Bureau
nvestigation shall have made an inves-
tion and report to the Commission on
character, associations, and loyalty of
individual and the Commission shall
determined that permitting such per-
to have access to restricted data will
endanger the common defense or secu-
". These two provisions insure a great
of control by the Commission over
personnel of research projects. And
control is somewhat increased by the
nce from the final draft of any ex-
t provision authorizing grants-in-aid
research work, although it is to be
ngly urged that the term "arrange-
ts" in its context is broad enough to
de grants-in-aid.

* * *

e control over the dissemination of
ic information is broad and the pen-
s and hazards for violation are ex-
e as established by the legislation.
legislation makes it a crime to com-
icate, transmit or disclose restricted
with intent to injure the United States
ith intent to secure an advantage to
foreign nation. It makes it a crime to
npt to acquire restricted data with
r such intent. "Restricted data"
s "all data concerning the manufac-
or utilization of atomic weapons, the
uction of fissionable, or the use of
nable material in the production of
r, but shall not include any data which
Commission from time to time de-
ines may be published without ad-
ly affecting the common defense and
rity".

a broad meaning is given to the term
ricted data", and if the Commission
not act to authorize publication, any
npt to further world science through
xchange of non-military but industri-
important information on atomic energy will constitute a crime. And it is conceivable also that the exchange of related medical information will constitute a crime, and not because the United States is injured but because a foreign country has been aided. These are obvious hazards and limitations on the freedom of scientific inquiry. Moreover the discretion of the Commission is limited by the assertion of Congressional policy in the Act that "until Congress declares by joint resolution that effective and enforceable international safeguards against the use of atomic energy for destructive purposes have been established, there shall be no exchange of information with other nations with respect to the use of atomic energy for industrial purposes". Domestic freedom is thus dependent upon international security.

On the other hand it appears that the legislation no longer authorizes the compartmentalization of restricted data within projects, even though the projects are conducted by arrangement with the Commission, in such a way as to deny information to persons determined by the Commission, after Bureau investigation, to be entitled to access to restricted data. Attention will have to be paid at all times, however, to "the applicable provisions of any other laws" which may place additional limitations on the exchange of information. Such limitations, however, will have to be in harmony with the broad purpose, as stated in the Atomic Energy Act, to permit and encourage the dissemination of scientific and technical information "so as to provide that free interchange of ideas and criticisms which is essential to scientific progress".

* * *

A compromise was achieved also as to the use of patents. Patents can no longer cover the production of fissionable material or the utilization of fissionable material or atomic energy for a military weapon. Patents are permitted where the coverage is the utilization of fissionable material or atomic energy for non-military purposes. Where such patents are granted, the Commission has the discretion to license the use of the invention. The compromise which was achieved therefore is similar to that worked out for the control of information except that where the dissemination of information is concerned, the use of fissionable material for the production of power is regarded as more clearly affected with the national interest.

* * *

When the Commission has been appointed, it will have certain immediate duties. It will have to establish regulations permitting the retention and providing for the distribution of fissionable materials. The possession or transfer of fissionable materials sixty days after the effective date of the Act will be unlawful without this permission. It will have to establish regulations and provide a procedure for the granting of licenses covering the transfer of source materials. In cooperation with the Federal Bureau of Investigation, the Commission will have to set up procedures for the certification of the loyalty of research workers. And no doubt the Commission will wish to at once take some steps towards the declassification of some restricted data within the limits set up by the Act. But there will be broader duties as well.

The Commission must organize itself for a program of federally conducted research and development work. It must either itself or through contractors using government equipment produce fissionable material. To insure a rapid and a healthy development of atomic energy in this country, it must make arrangements with private institutions for research and development work. It must begin a study of the industrial, commercial and other non-military uses of atomic energy so that it may make the necessary reports to the President and the Congress, as provided by the legislation, and so that it may be in a position to determine whether to issue licenses for this kind of manufacture or production which goes beyond the research or developmental stage.

In its work the Commission will be aided by a General Advisory Committee of nine part-time members appointed by the President. This advisory committee is part of the compromise which permitted the requirement that the Commission itself be composed of full-time members. The Commission also can be aided by advisory boards which it has the power to create. The Commission no doubt will work closely with a joint congressional committee on atomic energy brought into existence by the Act.

But in its administration of the compromises worked out in the legislation through which unprecedented power in a new field has been given to the government, the Commission must have the aid and constant criticism of non-governmental scientific groups. The Act represents a further experiment in governmentally controlled research. The limitations which have been placed on governmental powers will be more genuine if independent scientific groups remain active. Such aid and criticism will be even more important for that period when the hope expressed in the Act that "any provision of this Act or any action of the Commission to the extent that it conflicts with the provisions of any international arrangement made after the enactment of this Act shall be deemed to be of no further force or effect" remains unrealized.

Plans for Nuclear Research in U.S. . . .

The Argonne National Laboratory . . .

The successor of the Metallurgical Laboratory, one of the most important branches of the Manhattan Project, is the Argonne National Laboratory, so called after the Argonne Forest Preserve 30 miles west of Chicago, the location of one part of the Metallurgical Laboratory including the piles and accessory installations.

The Argonne National Laboratory has been established and is being supported by the Federal government. It is managed and operated by the University of Chicago as Contractor. Its administrative organs are a Council of Participating Institutions, a Board of Governors and the Director.

The Participating Institutions are twenty-five of the leading Universities and Research Institutes in the middle west. The charter members are:

Battelle Memorial Institute, Carnegie Institute of Technology, Case School of Applied Science, Illinois Institute of Technology, Indiana University, Iowa State College, Mayo Foundation, Michigan State College, Northwestern University, Notre Dame University, Ohio State University, Purdue University, St. Louis University, Washington University, Western Reserve University, University of Chicago, University of Cincinnati, University of Illinois, University of Iowa, University of Michigan, University of Minnesota, University of Missouri, University of Nebraska, University of Pittsburgh, University of Wisconsin.

Other institutions which, because of research interest, qualified personnel and geographical location, find it possible and to their advantage to take an active and constructive part in the cooperative program of the Laboratory may be considered as possible future Participating Institutions.

The Participating Institutions annually designate a Council of not more than 25 members. This Council elects a seven-man Board of Governors. The first Board of Governors consists of:

Prof. Farrington Daniels—University of Wisconsin (Chairman)

Dean O. W. Eshback—Northwestern University

Chancellor R. G. Gustavson—University of Nebraska

Chancellor A. H. Compton—Washington University

Prof. F. W. Loomis—University of Illinois

Dean J. T. Tate—University of Minnesota

Prof. F. H. Spedding—Iowa State College

The Director is Prof. Walter H. Zinn, formerly Director of the Argonne Laboratory under the Metallurgical Project. Drs. Norman Hilberry and Harvard L. Hull have been appointed Associate Directors.

The Director and the scientific staff of the Laboratory will have full responsibility for the formulation of the research program. When approved by the Board and the Government, the detailed implementation of the approved program will be the responsibility of the Director and the Contractor.

The scientific staff of the Laboratory will be made up of two classes (a) temporary staff members, and (b) regular staff members. Both classes will have the same opportunities for use of the Laboratory facilities in research upon approved programs, and both classes will be required to abide by the operating rules of the Laboratory.

Temporary staff membership is not limited to the staff members of the Participating Institutions. The Director may appoint any qualified scientist to temporary staff membership.

In order to achieve the objectives of the Laboratory, it is essential that it have in addition to its temporary staff, a regular staff fully qualified to initiate and carry out scientific investigations.

Current research and development programs will be continued and new programs in the field of atomic energy will be initiated, including the development and construction of new types of piles. It is intended that the research program emphasize the training of scientific personnel.

The programs at the Laboratory will include both fundamental research, largely unrestricted as to security regulations, and process or development research which may be of secret character. Emphasis will be placed on fundamental research requiring the use of piles or of other equipment of too great cost for a university or private research institution to underwrite, or i volving health hazards requiring tl special facilities and services of the Lab ratory. As a general policy, major dupl cating research programs will not be e couraged at the Laboratory if suitab personnel and facilities are actively e gaged in such programs at an associat institution, although individual membe of the staff may be concerned with su problems and will be expected to car on some work in such fields.

In addition to the scientific work carri on by the regular staff of the Laborato investigations may be arranged on a c operative basis with the scientific sta of the Participating Institutions as re resented by the Council, or with qualifi scientific investigators from other instit tions.

The research programs will emphasi work in nuclear physics and chemistry a in those phases of the physical, biologic and engineering sciences which are interest to the Atomic Energy Project a will include such other investigations the Director, the Board of Governors, a the Government may approve as appr priate due to peculiar requirements f use of special Laboratory facilities.

It is anticipated that all final results the Laboratory may be published in det in suitable government journals which m be classified or unclassified as the natu of the work and national security poli dictates. It is further anticipated th such unclassified government publicati will be given wide distribution and th such classified government publicati will be made available to other gover ment laboratories and contractors wo ing under its sponsorship in the same fie

Regardless of government publicati any regular or temporary member of t Laboratory will be at liberty to publ any unclassified results obtained at t Laboratory in any accepted scient journal and in such form as such journ may require.

Security requirements at the Laborat will be in accord with government polic in effect at the time. Membership on eith the regular or temporary staff of the La oratory will be subject to agreement abide by existing security regulations.

clear Research Center Camp Upton, N.Y.

ine leading educational institutions of East have cooperated to form Asso- ed Universities, Inc., which will oper- as contractor with the government, new atomic research center at Camp on, Long Island.

he nine universities comprising the up are Columbia, Cornell, Harvard, ns Hopkins, Massachusetts Institute Technology, Pennsylvania, Princeton, hester, and Yale.

r. Philip M. Morse, professor of phys- at Massachusetts Institute of Technol- and war-time consultant on scientific ects to the Navy Department, has n named as Director of Scientific Re- rch.

esign on machines, which will cost ap- imately $5,000,000, will start imme- ely. Research, according to Dr. Morse, be underway by early spring.

ontemplated technical installations in- e a cyclotron of 500,000,000 volts, a hrotron of comparable size, and a nium pile capable of producing a great ety of radiation useful in physical and ical research. The construction will ude laboratories devoted to biological, nical, physical, medical, and engineer- research. Ten or twelve buildings are ned on the tract of 3,700 acres turned to the project. The community, tech- l and non-technical, will comprise t 1,000 persons. The technical per- el will include a permanent staff as as scientists on leave from various ersities. Seminars for the staff and luate students from universities are ned in the summer.

he primary purpose of the project, ac- ing to Dr. Morse, will be one of pure arch, looking toward the peace-time ication of atomic energy in industrial medical fields and towards the train- of more experts in this new and im- ant field.

t should be emphasized," said Dr. se, "that the project is in no way lim- to scientists of the nine universities ed. Universities in general have a ition of leadership in pure research. project will enable and encourage scientists of all universities, not only he East but those from other sections he country, to cooperate in pure re- ch. The project is designed for the eration of scientists of the staffs of universities, large and small. By this eration, faculty members and gradu- students will have the opportunity to training in the new techniques of nu- r research."

The Oak Ridge Institute of Nuclear Studies

A problem that is receiving much attention in scientific circles today concerns the best procedure for ensuring the continuance and further development of broad fundamental research in the field of nuclear studies.

While there are differences as to procedure, the consensus appears to be that the broad national interest can best be served through the establishment of research centers for nuclear studies in several parts of the country.

The position of Oak Ridge as a possible location for one of these centers appears to be unique, both because of the elaborate facilities already built and in operation there and because of the presence of a large and active research group in the Clinton Laboratories already effectively engaged in such research. In view of this situation, a group of southeastern universities is sponsoring a plan looking toward the establishment of an Oak Ridge Institute of Nuclear Studies, where research at the Ph.D. level and above would be carried out in the fields of physics, chemistry, biology, medicine, and engineering.

The early establishment of such a cooperative Institute at Oak Ridge will have a number of important advantages in terms of the national interest in the development of atomic energy. Among these may be cited the following:

(1) The development of the Institute around the already existing research and production facilities at Oak Ridge can be accomplished with a minimum of delay so that cooperative research with universities can go forward actively at an early date.

(2) The cooperative Institute at Oak Ridge will serve as a prototype for the establishment of similar centers in other parts of the country. In the interim before the establishment of such other centers, research workers from universities in various parts of the country can be initiating research programs relating to nuclear studies, which otherwise would have to be delayed from one to three years.

(3) Two large isotope separation plants are being operated at Oak Ridge for the large-scale production of U 235 in addition to the research program being conducted at the Clinton Laboratories. Although these units are primarily industrial, the proximity of the large and active research group at the proposed Institute will be of great value in ensuring the vigorous development of these methods and in attracting and holding competent technical personnel for them.

(4) The location of a nuclear research center in the southeastern region is clearly important to the national interest. The recruiting of potential man power for work in this field has in the past been neglected except in limited regions of the country, notably the Northeast and the far West. With the location of a large and progressive research establishment in the Southeast, young men who otherwise would not be attracted to scientific work of this type will become interested.

(5) It is apparent that such research centers, wherever they are located, will have to be organized as geographically independent entities, and it will not, in general, be possible to locate them in close proximity to already existing educational or governmental institutions. The availability of an adequate amount of Government-owned land and the Government's existing large investment in facilities at Oak Ridge point toward this as one of the logical locations for the establishment of such a research center. In order to implement the establishment of such a cooperative Institute effectively, it will be necessary only to group and allocate properly such expanded research facilities as are contemplated at Oak Ridge in a common area where they can serve as the nucleus for the development of a future Institute. It is hoped that planning for the extension of research facilities at Oak Ridge will be done in such a way that these facilities can be brought together in a common area which would be appropriate for the future development of an Institute.

The national stake in the future of atomic energy is a vital one, and any steps that will assure that active research is not interrupted are of the utmost importance at this time. The effectiveness of such research depends on continued cooperation between private agencies, such as the universities and industry, and the Government. It therefore seems imperative that advantage be taken of the opportunity existing at Oak Ridge, with its established facilities and personnel, to develop immediately such cooperative research through the organization of an Institute for advanced nuclear studies.

MEMBERS OF THE EXECUTIVE COMMITTEE

W. G. Pollard, University of Tennessee, *Chairman*; P. W. McDaniel, Manhattan Engineer District, *Secretary-Treasurer*; J. P. Ferris, Tennessee Valley Authority; P. M. Gross, Duke University; D. E. Hull, Carbide & Carbon Chemicals Corporation; H. L. Hull, Tennessee Eastman Corporation; F. G. Slack, Vanderbilt University; and E. O. Wollan, The Clinton Laboratories, Monsanto Chemical Company.

Debate on World Government or Discussion of Atomic Energy Control . . . . *William T. R. F*

The Lilienthal report of March 16 and the Baruch proposals of June 14 have succeeded in evoking support from an extraordinarily broad spectrum of American opinion. Opponents and proponents of world government even ceased belaboring each other at least for the time it took them to proclaim their support of these proposals as embodying satisfactory minimum short-run goals. Is it possible that the great debate on world government has generated more heat than it should have and less light than it might have? It is difficult to explain their agreement with each other on this crucial question of public policy unless the earlier disagreements were more apparent than real.

We have Chancellor Hutchins's word for it that he knows of nobody who believes we can have world government this afternoon. He would have been equally hard put to find anybody who does not ardently wish for an end to the threat of atomic war by the abolition of the multiple-sovereignty system which has bred a dozen general wars in three hundred years. Yet much of the public discussion has been carried as if the one group naively believed that a miracle would cause the men of all nations suddenly to demand world government and as if the other really wanted atomic warfare and liked the multi-state system.

RECONCILIATION ACCOMPLISHED BY THE US PROPOSAL

How is it that those who said that nothing less than world government would prevent atomic war and those who said that it would be necessary to reconcile one's self to a great deal less have united in supporting the Baruch proposals? Both groups had taken as a major though generally unstated premise that it would not be possible to have just a segment of world government. Both believed that an efficient inspection process would have involved an international inspectorate in intervention in the daily activities of national governments and individual citizens at a myriad of points. Both believed that effective inspection would have been possible only if the world atomic energy control authority were able to intervene at will throughout the whole range of human activity.

To the world government advocates this meant that mankind had to make quickly a gigantic leap to create a world authority powerful enough to impose its will on even the greatest of existing states. To those who believed world government not possible in the near future and concluded that a solution had to be found within the framework of the existing multi-state system, this meant that national security and world freedom from atomic war could not be based solely on faith in a possibly inefficient inspecting process.

THE VIRTUES OF THE LILIENTHAL INSPECTION SCHEME

By pointing the way to a method of inspection that was both simpler and more efficient than had previously been thought possible, the Lilienthal Board of Consultants were able to satisfy the critics of world government on one count. A system that promises that, so long as no clear warning to the contrary has been given, there is no illicit production of atomic weapons or fissionable materials anywhere in the world permits a responsible statesman to agree to his own state's total atomic disarmament. A system which permits the underlying strategic balance to reassert itself in the event of a violation or breakdown of the atomic energy control agreements provides a solution within the framework of the multi-state system.

By giving to the world authority a monopoly in all "dangerous" activities in the atomic energy field and by permitting the redrawing whenever necessary of the line between safe and dangerous activities so that the control mechanism can be modified in the light of technological advances, the proposals permit that indefinite expansion of the authority's scope which the world government group has believed necessary. The direction of the expansion, however, is toward the end-point of a perfect monopoly by the world authority of all activities related to atomic energy. It is not toward that unrestricted expansion of the authority through every field of human activity which few statesmen would today agree in advance to permit.

It is precisely because the probable necessary expansion of the authority's field of action seems so modest that the one group believes that the proposals meet its minimum requirements and the other believes that they stay within the limits of what can now be agreed upon. Both groups have given up the belief that total world government is necessary to efficient inspection. Their reconciliation has thus become possible.

SANCTIONS AND THE EFFICIENCY OF INSPECTION

In this redefinition of positions differences between thoughtful studen the problems of atomic energy co seem to diminish. An inspectorate w might not discover until very late in day large-scale violations of atomic e gy control agreements would have t supplemented by a machinery of puni sanctions kept continuously ready. would have meant either national gov ments or an international authority in a state of total atomic prepared With an efficient inspection process, w promises a period of grace between sounding of the danger signal and be ning of atomic blitzkrieg, the debate the organization of sanctions coul postponed until the violator had rev himself and co-operation among the violators could be spontaneously devel This would be true if proper precau were taken to maintain an under strategic balance such that the world munity would not be defenseless ag a new disturber of the peace.

Even if nothing more were provide during the period of grace than that bets are off" and all nations free to vigorously their respective atomic a ments program and to co-operate in tive action against the atomic aggre advocates of world government and tics could join in expecting sponta co-operation. They can also join in ommendations on the course to be foll during the period of grace. So lon this period is assured and reasonably longed, they can agree upon the ability of organizing in advance a stantaneously operative machinery of tions which would operate without th of atomic weapons to crush the aggr before he could make decisive use o illegal atomic weapons. They could t fore further agree that, until the and unmistakable danger signal had given, there should be no legal a weapons in existence anywhere, e possibly those few necessary for the i national authority to keep its res program well ahead of that of any lator. There should be little difficul agreeing on that "immediate and con system of penalties which Mr. Baruch declared would have to be invoked ag a violator.

E CONSEQUENCES OF A YEAR CENSORSHIP

here is still another point upon which ideration of the Lilienthal report can note consensus. Much of the unneces- disagreement between participants in world government controversy might e been avoided if a more enlightened cy of declassifying secret material had followed. Certain elements of the enthal proposals were foreshadowed in Report of June 11, 1945 made to the retary of War by seven atomic scien- who constituted the non-official "Com- ee on Social and Political Implica- s."* In particular, their references to possibility of "compulsory denatura- " of fissionable materials to be made lable for peacetime power use and to possibility of "exact book-keeping" h would assure early detection of any ppropriated fissionable materials sug- that this report strongly influenced Lilienthal group. This committee thus gested two of the most striking fea- s of the Lilienthal report even before first experimental bomb was exploded New Mexico. It did not, it is true, ider the problem of preserving some tegic balance among states in order to an organized system of deterrents lable in case a great state violated its ement, nor does it refer to the neces- for creating an international author- with positive functions, which is the t and original contribution of the rd of Consultants. These, however, are ents of the Lilienthal-Baruch pro- ls which might have been developed ne early weeks of the debate had the rt of June 11 been made promptly lable or had barriers to communication reduced between scientist and non- ntist, and between scientist and sci- t. So much intellectual energy has spent trying to pierce the fog of orship that that available for working rd a reasoned consensus has been tly and unnecessarily reduced.

IE QUESTIONS STILL ANSWERED

hat issues then remain? The Lilienthal rt and subsequent developments in rican policy have not achieved a per- harmony among hitherto dissident ps. They should, however, focus dis- on on gaps in the Baruch proposals on critical points of doubt and dis- ement which remain. For example, it t at all clear how agreement can be tiated on a geographic dispersion of gerous" activities to be carried on by nternational Atomic Development Au- ty. Extremely difficult and technical lems of ratios of production, of loca- of production facilities and power plants, or relative rates of development and exploitation of raw material resources have hardly yet been discussed. Nor has there been searching analysis of the difficulties of recruiting personnel for an international authority in such a way that the creative impulses of the scietific personnel will not be stifled by an incomplete disaffiliation from previous national loyalties.

Some questions which seem to require further discussion follow:

(1) **To what extent must any plan for atomic energy control be negotiated as a whole?** Are there any preliminary steps to which the United States might first agree, such as the outlawry of atomic weapons? In a stage-by-stage plan would it be feasible to negotiate and implement the first stage before negotiating the second stage?

(2) **To what extent must a complete control plan be implemented immediately?** The Lilienthal-Baruch proposals call for stage-by-stage implementation, presumably over a period of years, with a nicely calculated balance of benefit and sacrifice at each stage and a line of retreat left open, through maintenance of the underlying balance, at all stages in case of violation or breakdown. The Baruch proposals' efficacy depends, however, on the inspectorate having to inspect only for forbidden activities. The longer the period before the full plan is in operation the greater the problem of assuring each participant that no other participant had produced and secreted stockpiles of forbidden materials. If implementation were long delayed, the inspectorate would have to search not only for illicit activity but forbidden materials, and the inspecting process would again become complex and of dubious efficacy.

(3) **Is it feasible to negotiate a plan for atomic energy control apart from a plan for punitive sanctions?** The answer to this question, as has been indicated earlier in this article, depends on calculations regarding the probable efficiency of the inspecting process and the duration of the period of grace. On the answer to this question depends a judgment on the role of the veto in the present UN negotiations.

(4) **It is wise to attempt the control of atomic weapons apart from the control of other instruments of mass destruction?** Would successful negotiation and operation of an atomic energy control agreement give the participating governments confidence to proceed to control agreements for other possibly equally menacing weapons? Would separate negotiation of atomic energy control leave the nation which gives up it atomic armaments defenseless against the first nation whose scientists developed say a DDT for human beings?

(5) **Is there any line between "safe" and "dangerous" activities short of the line between activities related to atomic energy and all other activities?** If a great-power veto could be interposed to prevent a shift of the line in the light of technical advances, it might be better to begin by giving the world atomic development authority a complete monopoly.

(6) **To what extent is it necessary to restrict the development of atomic energy for peacetime power purposes in order to assure safety or to maintain the underlying strategic balance?** If the power use for atomic energy were to be given up, the simple way to maintain a strategic balance would be to prohibit all except miniscule atomic energy production installations. These would take care of medical and research requirements. If the peacetime power possibilities are to be developed, the political and economic criteria of the feasibility of specific power installations need examination.

(7) **Must there be a formal and explicit yielding of the veto if atomic energy control is to be achieved?** This appears at present to be the key question, but the answer to it depends upon the answer to other questions listed above. If enforcement is separable from control, if an unobstructed right of inspection is assured, if the redrawing of the line between safe and dangerous activities is not subject to veto, perhaps the gap between the Soviet and American positions can be closed and genuine agreement achieved.

STAFF REORGANIZATION IN THE NATIONAL COMMITTEE ON ATOMIC INFORMATION

The Executive Committee of the National Committee on Atomic Information has announced the following changes in and additions to its national staff:

Mr. Daniel Melcher resigned as Director on July 29.

Dr. Helen Dwight Reid, Vice-Chairman of NCAI, and director of the international relations activities of the American Association of University Women, is serving for a few weeks as Acting Director.

Mr. Livingston Hartley, noted writer on foreign affairs who served in the Navy during the war, will be Editorial Director, editing all NCAI publications, including Atomic Information, the NCAI Periodical.

Mr. A. E. Casgrain formerly the Chief of Group Liaison for UNRRA will serve as consultant on the relations of NCAI with member and cooperating organizations.

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"OUR ATOMIC WORLD" PUBLISHED

The pamphlet "Our Atomic World," written by J
R. E. Marschak, E. C. Nelson and L. I. Schiff, all mem
of the Los Alamos Atomic Bomb Project, and pub
by the University of New Mexico Press, is now ava
The pamphlet contains a foreword by Prof. E. F
The chapter on "Atomic Bomb Damage—Japan and
appeared in the **Bulletin** v. 1, No. 10.

"Our Atomic World" will be on sale at news s
Copies may be obtained from the National Committ
Atomic Information, 1749 L St. N.W. Washington,
or from the University of New Mexico Press, Albuqu
N.M. The price is 50c.

FEDERATION OF AMERICAN SCIENTI

The Federation of American Scientists has anno
the results of the election of the incoming Administ
Committee. The seven members are: Albert E.
David Hawkins, William A. Higinbotham, Philip
son, Melba Phillips, Joseph H. Rush, Robert R. Wil
The officers of the Federation will be elected a
next meeting of the Council to be held in New York
on Sept. 22 and 23.

The present issue constitutes a double numb
Volume 2, Nos. 5 and 6. The price of a single
of this issue is 20c.

Material in this Bulletin is released for publicatio
12 noon, Thursday, September 12.

BULLETIN OF THE ATOMIC SCIENTISTS

EDITORS:

H. H. Goldsmith **E. Rabinowitch**

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LETIN of the
ATOMIC SCIENTISTS . . .
L. 2 OCTOBER 1, 1946 Nos. 7 and 8

ditorial:

eadlock or Slow Progress? . . .

he very slow-moving deliberations of the UN Atomic Ener- Commission has resulted in a widespread feeling of anxiety r this tendency to drift. Since the possibility of influencing official Soviet attitude by contact with Russian scientists or eal to public opinion in the Soviet Union appears, at best, remote, criticism naturally turns to our own policy. It sked whether the Baruch plan was the best proposal we d have made to make international control of atomic ener- acceptable to the Russians, and whether it was presented in proper spirit to ensure friendly reception. Criticism along e lines has been voiced here and abroad, particularly elo- ntly in Secretary Wallace's letter to President Truman on 23.

Wallace's main objection was that the American proposal en- ged, as the first step, the disclosure by all nations of their urces, but that the timing of further steps, including the ase of American scientific and technical information, cessa- of bomb production and destruction of existing bombs, was to the discretion of the United States. Wallace suggested the only way to obtain Russian cooperation is by agreeing complete time schedule right from the beginning.

A second point critcized by Wallace (and others) was the gested abolition of veto power in atomic energy matters—a posal which arouses violent Soviet opposition and which lace termed "completely irrelevant."

ately, a third objection to Baruch's plan has been attributed he Russians—their alleged apprehension that the Atomic elopment Authority, by exercising rol over what might become an im- ant source of industrial power, can e as a means to subject the socialist omy of the USSR to domination by capitalist economies of the West.

* * *

s pointed out in the statement of Mr. uch printed in this Bulletin, and was eded by Wallace, the first criticism is supported by the official text of Amer- statements. It is deplorable that such understandings should arise. We can- afford to split American public opinion porting international control along par- n political lines. The American ADA- undoubtedly constitutes a radical de- ure from the traditional principles of onal sovereignty and private enter- e. Nevertheless, it has found support- not only in internationalist or social- ally-inclined groups, but also in con- ative circles. Not so long ago, those proposed international control were ribed as radicals whose true aim is to e the secret to the Russians." Now, near suspicions that international control is a tricky device to establish the ascendancy of American capitalism over the whole world. We prefer to assume that whoever attempts to think through the facts and implications of atomic energy—and honest thinking is not the prerogative of a single political or economic group—inevitably arrives at the conclusion that nothing short of effective international control can provide security to this or any other country. We need wholehearted cooperation of all who have reached this conclusion. It will be difficult enough to achieve the establishment of international control even by a concerted effort of the whole American nation; this aim will never be reached by forces of a partisan minority alone.

* * *

Appealing for national unity in the fight for international control does not mean that we suggest that the world be confronted with an uncompromising support of the American plan. On the contrary, we should make it clear that the only thing on which no bargaining is possible, is the principle of effective international control itself. For the rest, suggestions for the amendment to the American plan, or even entirely new plans, must be welcomed. The American delegation can point out that such was its official attitude from the very beginning. Nevertheless, it seems true that the opposite impression has arisen even in some friendly delegations. The attitude of a part of the American press may have contributed to this impression. It is to be hoped that the statement just issued by Mr. Baruch will help to dispel these misapprehensions.

That a change of veto provisions of the Charter, however desirable, is not an essential part of a settlement of the atomic energy problem, was argued in this place before (Bulletin, Vo. 2, No. 1-2). The principle of international ownership or managerial control of "dangerous" activities (as opposed to control through inspection of national developments) is one which we are loath to give up. It gave to the Lilienthal board report its imaginative and inspiring quality. We hope that it can be implemented in such a way as to allay Soviet misgivings that it will endanger the economic system of the USSR. (After all, this program can equally well be considered as a threat to private enterprise throughout the world!) But if the Soviet leaders are afraid of the ADA and prefer to discuss inspection as means of ensuring atomic disarmament, we must be prepared to negotiate on this basis too. We may recall that it took us six months or more to progress from the first tentative inspection plans to the much more ambi-

(Continued on page 29)

IN THIS ISSUE

from the Letter to the President . . .

(July 23, 1946) . . . . Henry A. Walla

The letter which former Sec'y of Commerce Wallace addressed to President Truman on July 23 and which was published on Sept. 17, is an eloquent statement of Mr. Wallace's point of view on American foreign policy. We reprint that portion of the letter devoted to the question of international control of Atomic energy because of its importance as the first criticism of the Baruch plan to come from an authoritative American source. Mr. Wallace's remarks on this subject deserve close consideration, independently of general approval or disapproval of the remainder of his letter.

As we go to press Mr. Baruch has publihed a detailed answer to Mr. Wallace's criticisms. This statement is printed on pages 4 and 5 of this issue.

There can be no doubt that the American people want and expect that their leaders will work for an enduring peace. But the people must necessarily leave to their leaders the specific ways and means to this objective. I think that at the moment the people feel that the outlook for the elimination of war is dark, that other nations are wilfully obstructing American efforts to achieve a permanent peace.

How do American actions since V-J day appear to other nations? I mean by actions, the concrete things like $13,000,000,000 for the War and Navy Departments, the Bikini tests of the atomic bomb and continued production of bombs, the plan to arm Latin America with our weapons, production of B-29's and planned production of B-36's and the effort to secure air bases spread over half the globe from which the other half of the globe can be bombed. I cannot but feel that these actions must make it look to the rest of the world as if we were only paying lip service to peace at the conference table.

These facts rather make it appear either (1) that we are preparing ourselves to win the war which we regard as inevitable or (2) that we are trying to build up a predominance of force to intimidate the rest of mankind. How would it look to us if Russia had the atomic bomb and we did not, if Russia had 10,000-mile bombers and air bases within 1,000 miles of our coast lines and we did not?

Some of the military men and self-styled "realists" are saying: "What's wrong with trying to build up a predominance of force. The only way to preserve peace is for this country to be so well armed that no one will dare attack us. We know that America will never start a war."

The flaw in this policy is simply that it will not work. In a world of atomic bombs and other revolutionary weapons, such as radioactive poison gases and biological warfare, a peace maintained by a predominance of force is no longer possible.

Why is this so? The reasons are clear.

First, atomic warfare is cheap and easy compared with old-fashioned war. Within a very few years several countries can have atomic bombs and other atomic weapons. Compared with the cost of large armies and the manufacture of old-fashioned weapons, atomic bombs cost very little and require only relatively small part of a nation's production plant and labor force.

Second, so far as winning a war is concerned, having more bombs — even many more bombs—than the other fellow, is no longer a decisive advantage. If another nation had enough bombs to eliminate all our principal cities and our heavy industry, it wouldn't help us very much if we had 10 times as many bombs as we needed to do the same to them.

Third, the most important, the very fact that several nations have atomic bombs, will inevitably result in a neurotic, fear-ridden, itching-trigger psychology in all the peoples of the world, and because of our wealth and vulnerability we would be among the most seriously affected.

Atomic war will not require vast and time-consuming preparations, the mobilization of large armies, the conversion of a large proportion of a country's industrial plants to the manufacture of weapons. In a world armed with atomic weapons, some incident will lead to the use of those weapons.

There is a school of military thinking which recognizes these facts, recognizes that when several nations have atomic bombs, a war which will destroy modern civilization will result and that no nation or combination of nations can win such a war. This school of thought, therefore, advocates a "preventive war", an attack on Russia now before Russia has atomic bombs.

This scheme is not only immoral but stupid. If we should attempt to destroy all the principal cities and her heavy industry, we might well succeed. But the immediate counter-measure which such an attack would call forth is the prompt occupation of all continental Europe by the Red Army. Would we be prepared to destroy the cities of all Europe in trying to finish what we had started?

This idea is so contrary to all the basic instincts and principles of the American people that any such action would be possible only under a dictatorship at home. Thus the "predominance of force" and the notion of a "defensive attack' both unworkable.

The only solution is the one which have so wisely advanced and which f the basis of the Moscow statemen atomic energy. That solution consis mutual trust and confidence among tions, atomic disarmament and an tive system of enforcing that disa ment.

There is however, a fatal defect i Moscow statement, in the Acheson r and in the American plan recently sented to the United Nations Atomi ergy Commission.

That defect is the scheme, as it is erally understood, of arriving at int tional agreements by "many stage requiring other nations to enter into ing commitments not to conduct res into the military uses of atomic e and to disclose their uranium and th resources while the United States r the right to withhold its technical k edge of atomic energy until the int tional control and inspection syst working to our satisfaction.

In other words, we are telling the sians that if they are "good boys" w eventually turn over our knowled atomic energy to them and to the nations. But there is no objective dard of what will qualify them as "good" nor any specified time for sl the knowledge.

Is it any wonder that the Russia not show any great enthusiasm f plan? Would we have been enthu if the Russians had a monopoly of energy and offered to share the in tion with us at some indefinite time future at their discretion if we now not to try to make a bomb an them information on our secret res of uranium and thorium?

I think we would react as the R appear to have done. We would ha up counter-proposals for the reco our real effort would go into try make a bomb so that our bargainin tion would be equalized. That is sense of the Russian position, w very clearly stated in the Pravda of June 24, 1946.

It is perfectly clear that the "s step plan" in any such one-sided not workable. The entire agreeme have to be worked out and wrappe a single package. This may invol tain steps or stages, but the tim such steps must be agreed to in the master treaty. Realistically, Rus two cards which she can use in n ing with us:

. Our lack of information on the state her scientific and technical progress on nic energy, and

. Our ignorance of her uranium and rium resources.

hese cards are nothing like as power- as our cards—a stock-pile of bombs, nufacturing plants in actual produc-, B-29s and B-36s and our bases cov-g half the globe. Yet we are in effect ing her to reveal her only two cards nediately—telling her that after we e seen her cards we will decide wheth-ve want to continue to play the game.

nsistence on our part that the game t be played our way will only lead to eadlock. The Russians will redouble r efforts to manufacture bombs, and may also decide to expand their "se-ty zone" in a serious way.

p to now, despite all our outcries inst it, their efforts to develop a secur- zone in Eastern Europe and in the dle East are small change from the t of view of military power as com-ed with our air bases in Greenland, nawa and many other places thousands niles from our shores.

e may feel very self-righteous if we se to budge on our plan and the Rus-s refuse to accept it, but that means one thing—the atomic armament is on in deadly earnest.

am convinced therefore that if we are achieve our hopes of negotiating a ty which will result in effective inter-onal atomic disarmaments, we must ndon the impractical form of the p-by-step" idea which was presented he United Nations atomic energy com-ion.

e must be prepared to reach an agree-t which will commit us to disclosing rmation and destroying our bombs at ecified time or in terms of specified ons by other countries, rather than at unfettered discretion.

we are willing to negotiate on this s, I believe the Russians will also otiate seriously with a view to reach-an agreement.

here can be, of course, no absolute rance the Russians will finally agree workable plan if we adopt this view. y may prefer to stall until they also e bombs and can negotiate on a more l basis, not realizing the danger to nselves as well as the rest of the ld in a situation in which several ons have atomic bombs.

ut we must make the effort to head he atomic bomb race. We have every-g to gain by doing so, and do not up anything by adopting this policy he fundamental basis for our nego-on.

uring the transition period toward scale international control, we re- our technical know-how, and the only existing production plants for fissionable materials and bombs remain within our borders.

The Russian counter-proposal itself is an indication that they may be willing to negotiate seriously if we are. In some respects their counter-proposal goes even further than our plan and is in agreement with the basic principles of our plan, which is to make violations of the proposed treaty a national and international crime for which individuals can be punished.

It will have been noted that in the preceding discussion I have not mentioned the question of the so-called "veto". I have not done so because the veto issue is completely irrevelant, because the proposal to "abolish the veto", which means something in the general activities of the Security Council, has no meaning with respect to a treaty on atomic energy.

If we sign a treaty with other nations, we will all have agreed to certain things. Until we arrive at such a treaty, we as well as the other major powers will have the power to veto. Once the treaty is ratified, however, the question of veto becomes meaningless.

If any nation violates the treaty provision, say of permitting inspection of suspected illegal bomb-making activities, what action is there that can be vetoed? As in the case of any other treaty violations the remaining signatory nations are free to take what action they feel is necessary, including the ultimate step of declaring war.

We should try to get an honest answer to the question of what the factors are which cause Russia to distrust us, in addition to the question of what factors lead us to distrust Russia. I am not sure that we have as a nation or an administration found an adequate answer to certain questions, although we have recognized that both questions are of critical importance.

We should not pursue further the question of the veto in connection with atomic energy, a question which is irrevalent and should never have been raised. We should be prepared to negotiate a treaty which will establish a definite sequence of events for the establishment of international control and development of atomic energy.

This, I believe, is the most important single question and the one on which the present trend is definitely toward deadlock rather than ultimate agreement.

Mr. Wallace returned to the atomic energy question in the summary at the end of his letter:

This proposal admittedly calls for a shift in some of our thinking about international matters. It is imperative that we make this shift. We have little time to lose. Our postwar actions have not yet been adjusted to the lessons to be gained from experience of Allied cooperation during the war and the facts of the atomic age.

It is certainly desirable that, as far as possible, we achieve unity on the home front with respect to our international relations; but unity on the basis of building up conflict abroad would prove to be not only unsound but disastrous.

I think there is some reason to fear that in our earnest efforts to achieve bi-partisan unity in this country we may have given way too much to isolationism masquerading as though realism in international affairs.

The real test lies in the achievement of international unity. It will be fruitless to continue to seek solutions for the many specific problems that face us in the making of the peace and in the establishment of an enduring international order without first achieving an atmosphere of mutual trust and confidence.

The task admittedly is not an easy one. There is no question, as the Secretary of State has indicated, that negotiations with the Russians are difficult because of cultural differences, their traditional isolationism and their insistance on a visible quid pro quo in all agreements.

But the task is not an insuperable one if we take into account that to other nations our foreign policy consists not only of the principles that we advocate, but of the sections we take.

Fundamentally, this comes down to the point discussed earlier in this letter, that even our own security, in the sense that we have known it in the past, cannot be preserved by military means in a world armed with atomic weapons.

The only type of security which can be maintained by our own military force is the type described by a military man before the Senate Atomic Energy Commission—a security against invasion after all our cities and perhaps 40,000,000 of our city population have been destroyed by atomic weapons.

That is the best that "security" on the basis of armaments has to offer us. It is not the kind of security that our people and the people of the other United Nations are striving for.

I think that progressive leadership along the lines suggested above would represent and best serve the interests of the large majority of our people, would reassert the forward looking position of the Democratic Party in international affairs, and, finally, would arrest the new trend towards isolationism and a disastrous atomic world war.

Memorandum to the President

(September 24, 1946) . . . . . . Bernard M. Baruc

Secretary Wallace's letter of July 23, 1946, on foreign policy includes a discussion of the international control of atomic energy. The United States Delegation to the United Nations Atomic Energy Commission had no knowledge of this letter prior to its appearance in the press on September 18. The letter contains a number of statements purporting to describe the United States proposals for atomic energy control which are directly at variance with the facts as repeatedly stated in widely published documents well before the time when the letter was written. There are also misunderstandings as to the proposals made by the Soviet Union.

This memorandum is intended simply to point out the major errors of fact with a view to setting the record straight. It does not attempt to cover every detail or to restate the entire United States position. Secretary Wallace's letter also contains some mistaken conclusions, which were the inevitable result of the errors of fact. In this field, as in all others, sound conclusions can be based only on the facts.

The misstatements in Secretary Wallace's letter may be summarized under five headings. They are:

(1) the method of determining the stages of transition to the ultimate control plan,
(2) the content and sequence of these transition stages,
(3) the proposed limitation on the Great Power veto,
(4) the nature of the Soviet proposal,
(5) the refusal by the United States to depart from the principles of its plan.

1. METHOD OF DETERMINING STAGES OF TRANSITION

(a) Secretary Wallace's Statements

> "There is, however, a fatal defect in the Moscow statement, in the Acheson report **and in the American plan recently** presented to the United Nations Atomic Energy Commission. **That defect is the scheme, as it is** generally understood, of arriving at international agreements by 'many stages', of requiring other nations to enter into binding commitments not to conduct research into the military uses of atomic energy and to disclose their uranium and thorium resources while the United States retains the right to withhold its technical knowledge of atomic energy until the international control and inspection system is working to our satisfaction."

Secretary Wallace repeatedly suggests that under the United States plan, both the timing of the transition and the sequence of steps would be left to the sole discretion of the United States. Thus he says "there is no objective standard of what will qualify them (the Russians) as being 'good' nor any specified time for sharing our knowledge." And again, he refers to offering to share the information "at some indefinite time in the future" at our discretion.

In place of the United States proposal, as he conceives it, Secretary Wallace calls for a clear definition of the transition stages to full international control, negotiated in advance as part of the treaty. Thus he says:

> "It is perfectly clear that the 'step-by-step' plan in any such one-sided form is not workable. The entire agreement will have to be worked out and wrapped up in a single package. This may involve certain steps or stages, but the timing of such steps must be agreed to in the initial master treaty."

He repeats this thought later in the following paragraph:

> "I am convinced therefore that if we are to achieve our hopes of negotiating a treaty which will result in effective international atomic disarmaments we must abandon the impractical form of the 'step-by-step' idea which was presented to the United Nations Atomic Energy Commission. We must be prepared to reach an agreement which will commit us to disclosing information and destroying our bombs at a specified time or in terms of specified action by other countries, rather than at our unfettered discretion. If we are willing to negotiate on this basis, I believe the Russians will also negotiate seriously with a view to reaching an agreement."

(b) **The Facts**

Secretary Wallace's statements reflect complete ignorance of the United States position. Prior to July 23, we had made clear in three widely published documents that the United States proposal contemplates the very method of determining the stages of transition which Mr. Wallace endorses.

In the first paragraph quoted above, Mr. Wallace appears to condemn the whole idea of approaching the atomic energy problem by stages. It should be noted that this idea is not a unilateral proposal of the United States. Long before its presentation in the Acheson-Lilienthal Report and in the official statement of the United States position to the Atomic Energy Commission, it had been specifically endorsed in the Moscow Resolution, signed last December by the Soviet Union, the United Kingdom, and ourselves, and again in January by the unanimous vote of the United Nations General Assembly .

At a later point, Secretary Wallace r
ognizes the need for "certain steps
stages," but objects to the allegedly "o
sided form" in which these stages wo
proceed and the alleged proposal for t
ing the stages at the sole discretion of
United States. He advocates instead t
the stages "be worked out and wrap
up in a single package," agreed to in
vance "in the initial master treaty."

This is exactly the United States p
posal on this point, as the following q
tations show. Thus Mr. Wallace is ar
ing vigorously for the official Uni
States position, while treating it as if
proposal had been entirely different.

In the original presentation of
United States proposal at the first m
ing of the United Nations Atomic Ene
Commission on June 14, I said:

> "Progress by Stages. A primary ste
> in the creation of the system of co
> trol is the setting forth, in compr
> hensive terms, of the functions, r
> sponsibilities, powers, and limitatio
> of the Authority. Once a charter f
> the Authority has been adopted, th
> Authority and the system of contr
> for which it will be responsible wi
> require time to become fully orga
> ized and effective. The plan of co
> trol will, therefore, have to com
> into effect in successive stages. Tho
> **should be specifically fixed in th**
> **charter or means should be otherwi**
> **set forth in the charter for transitio**
> **from one stage to another, as conte**
> **plated in the resolution of the Unit**
> **Nations Assembly which created th**
> **Commission."**

(underscoring supplied)

Memorandum No. 1, submitted to
Commission by the United States Re
sentative on July 2 stated:

> "The treaty should contain provisio
> governing the sequence and timing
> the steps in the transition from th
> present conditions to the conditio
> which will prevail once the Authori
> is in effective control of atomic ene
> gy."

And again on July 5, in Memoran
No. 2, the United States Representa
stated:

> "Obviously, the controls outlined
> this memorandum cannot spring in
> existence full-grown and comple
> upon the legal establishment of t
> Authority. The process of putti
> them into effect will necessarily e
> tend over a considerable period
> time. It will have to be done
> stages provided in the treaty or cha
> ter and according to pre-arrang
> schedules based on sound and logic
> sequence leading to full and effecti
> establishment of all controls."

We have carefully examined the re
in an effort to find the source of Secre
Wallace's complete misunderstanding
the United States position on the me
of determining the transition stages.

ord contains nothing to support his w. Neither the Soviet delegate nor any er representative on the Atomic Ener- Commission has interpreted the United tes proposals as Mr. Wallace has.

CONTENT AND SEQUENCE OF TRANSITION STAGES

a) Secretary Wallace's Statements

s indicated above, Secretary Wallace's er states that the U. S. proposal con- s the

fatal defect . . . of requiring other ations to enter into binding commit- ents not to conduct research into the ilitary uses of atomic energy and to isclose their uranium and thorium esources while the United States re- ins the right to withhold its tech- ical knowledge of atomic energy until e international control and inspec- on system is working to our satis- ction."

t a later point, he implies that our osal would require that the Soviet on agree now not to try to make a b and give us information on their et resources of uranium and thorium, e we maintain for an indefinite period at our own discretion the United es monopoly of atomic energy.

) The Facts

here is no foundation in the record Secretary Wallace's description of the ted States proposals regarding the re and sequence of the transition es. Thus far, no specific proposal has made to the Atomic Energy Commis- on the content and sequence of the sition stages, although a memoran- covering this point has been promised submission at the appropriate time. delegation has felt it futile to make iled proposals on this point until there ome reasonable prospect of basic ement on the broad principles of the —control through an international ority responsible for the operation of dangerous activities and supervision ther activities in the field of atomic gy, supplemented by a system of in- tion and machinery for swift punish- of violations. It is hardly possible scuss the details of the transition un- eneral agreement is in sight on the re of the goal toward which the sition is to lead.

has always been recognized that the se content, sequence and timing of transition would be the subject of led negotiation since the process of sition involves a shift from the pres- osition of the United States to a ion of equality in the field of atomic gy among all nations participating e plan.

should be obvious that in any treaty might be negotiated, the same obli- ns would be assumed by all countries We have not asked others to re- from research on the military use omic energy and would not ask this unless we were prepared to cease such research ourselves. We have not asked others to disclose their own material resources and would not do so unless we were prepared to disclose our own.

3. MODIFICATION OF THE GREAT POWER VETO

(a) Secretary Wallace's Statements

Secretary Wallace's letter states that:

"the veto issue is completely irrelevant, because the proposal to 'abolish the veto', which means something in the general activities of the Security Council, has no meaning with respect to a treaty on atomic energy. If we sign a treaty with other nations, we will all have agreed to do certain things. Until we arrive at such a treaty, we as well as the other major powers will have the power to veto. Once the treaty is ratified, however, the question of veto becomes meaningless. If any nation violates the treaty provision, say of permitting inspection of suspected illegal bomb-making activities, what action is there that can be vetoed? As in the case of any other treaty violations, the remaining signatory nations are free to take what action they feel is necessary, including the ultimate step of declaring war."

(b) The Facts

The statement on the question of the veto in my opening address to the Commission on June 14 was as follows:

"It would be a deception, to which I am unwilling to lend myself, were I not to say to you and to our peoples, that the matter of punishment lies at the very heart of our present security system. It might as well be admitted, here and now, that the subject goes straight to the veto power contained in the Charter of the United Nations so far as it relates to the field of atomic energy. The Charter permits penalization only by concurrence of each of the five great Powers; the Soviet Union, the United Kingdom, China, France and the United States.

"I want to make very plain that I am concerned here with the veto power only as it affects this particular problem. There must be no veto to protect those who violate their solemn agreements not to develop or use atomic energy for destructive purposes."

This statement was elaborated in Memorandum No. 3, submitted to the Commission by the U. S. Representative on July 12 and widely published in the press. We said at that time:

"The controls established by the treaty would be wholly ineffectual if, in any such situations, to be defined in the treaty, the enforcement of security provisions could be prevented by the vote of a state which has signed the treaty. Any other conception would render the whole principle of veto ridiculous. It is intended to be an instrument for the protection of nations, not a shield behind which deception and criminal acts can be performed with impunity. This in no way impairs the doctrine of unanimity. No state need be an unwilling party to the treaty. But every state which freely and willingly becomes a party to the treaty, by this act, solemnly and firmly binds itself to abide by its undertakings. Such undertakings would become illusory, if the guarantee against their breach resided solely in the conscience of the one who commits the breach.

"Voluntary relinquishment of the veto on questions relating to a specific weapon, previously outlawed by unanimous agreement because of its uniquely destructive character, in no wise involves any compromise of the principle of unanimity of action as applied to general problems or to particular situations not foreseeable and therefore not susceptible to advance unanimous agreement."

There is of course no difference of opinion as to Secretary Wallace's statement that until we arrive at a treaty, not only the major powers but all nations will have an effective veto over any proposals. But our plan has never taken issue with this kind of veto. Once the treaty has been ratified, the veto becomes highly relevant. It should not then be available as a possible means of protecting wrong-doers from punishment called for by the treaty itself. Nor could the Atomic Development Authority function effectively unless the veto were removed as a possible hindrance to its day-to-day administrative operations.

In answer to Secretary Wallace's specific question, the action which might be vetoed is a proposal to punish a violation of the treaty. Thus, the U. S. proposal is designed to extend as far as possible the domain of effective international law in support of peace by defining the various classes of crimes, providing for judicial determination of guilt, and setting up machinery for carrying out appropriate punishments. This proposal is in sharp contrast with the assumption that the only possible sanction against international crimes is resort to the ultimate political measure of war—an assumption seemingly made by Mr. Wallace. Even if resort to war should prove necessary as a punishment, this action should not be a mere series of unilateral steps by the nations who "are free to take what action they feel is necessary," as Mr. Wallace says, but should rather be united action pursuant to a recognized international agreement.

4. NATURE OF THE SOVIET PROPOSAL

(a) Secretary Wallace's Statements

Secretary Wallace's letter states:

"The Russian counter-proposal itself is an indication that they may be willing to negotiate seriously if we are. In some respects their counter-proposal goes even further than our plan and is in agreement with the basic principles of our plan, which is to make violations of the proposed treaty a national and international crime for which individuals can be punished."

(Continued on page 31)

The Scientific and Technical Aspects of Atomic Energy Control . . . . *A First Repo*

. . . by the Scientific and Technical Committee of the UN Atomic Energy Commission

Letter of Transmittal:

To the Chairman of Committee 2:

Herewith is presented to Committee 2 a report from the Scientific and Technical Committee entitled "A FIRST REPORT ON THE SCIENTIFIC AND TECHNICAL ASPECTS OF THE PROBLEM OF CONTROL." This report was prepared in response to a request from Committee 2 made on 31 July 1946, that the Scientific and Technical Committee present a report on the question of whether effective control of atomic energy is possible, together with an indication of the methods by which the Scientific and Technical Committee considers that effective control can be achieved.

The report being presented deals with the scientific and technical features of atomic energy and their bearing on the problem of control. The scientific information included is non-secret and has previously appeared in published material. Our discussions were carried on in an amicable spirit, and there is unanimous agreement on the content of our report. I will not try to summarize here the conclusions of the report, since this has already been done in its last chapter.

Our Committee has discussed the possible release of the report for publication and has concluded that this decision should be made by Committee 2, inasmuch as the report was prepared for its use. However, we see no objection to the release of the report if this course of action should appear desirable.

We express our sincere hope that the report will help the Members of Committee 2 in clarifying their thought and in providing a useful basis for their discussions.

Professor H. A. Kramers
Chairman, Scientific and Technical
Committee of the Working Committee

27 September 1946
Lake Success, Long Island

TABLE OF CONTENTS

INTRODUCTION:

Nuclear physics was already a well-developed science when uranium fission was discovered in January 1939. Numerous nuclear transformations, some of them spontaneous, others induced artificially in the laboratory, were recognized as such and understood in considerable detail. It was known that nuclear energy was often set free in such transformations. Against this background, the discovery of fission was an interesting scientific event that added one more type of transformation which eventually found its natural place within the scientific picture.

But in the world of practical affairs, nuclear fission soon proved to be a discovery of the greatest consequence. Indeed, fission made possible a self-propagating release of enormous quantities of nuclear energy by means of a self-sustaining chain reaction. The first application was to mass destruction on a staggering scale. But, at the same time, the way opened to a new era of industrial and scientific achievem

On 31 July 1946, Committee 2 made the suggestion " the Scientific and Technical Committee present a report on question of whether effective control of atomic energy is possible, together with an indication of the methods by wh the Scientific and Technical Committee considers that effec control can be achieved." At the beginning of our discuss it was realized that a broad exploration of the technic possible methods of controlling atomic energy to ensure aga its use as a weapon would inevitably lead us to the consid tion of problems of a non-technical or political nature, wh would have to be taken into account in a system of cont Since political matters are wholly within the jurisdiction other committees of the Atomic Energy Commission, it decided to limit ourselves strictly to the scientific and techn aspects of the question.

International negotiations may lead in the future to definite tical agreements, which would determine upon a system of trol. In preparing this report, we have not made any sugions as to the nature of such a possible future control em. The report is intended rather to draw attention to scientific and technical facts which have to be considered evising any system of control.

In approaching our task, we have constantly kept in mind the problem before the United Nations Atomic Energy mission is not solely the question of what to do about a htful weapon, but rather the entire problem of what use l be made of a discovery so great that its consequences affect the future of human society.

Broadly speaking our report falls into the two following s:

First, we present the basic scientific and technical facts erning the domain of atomic energy and show that the rities leading to peaceful and destructive ends in this ain are so intimately interrelated as to be almost inrable (Chapters I and II).

Secondly, we analyze the principal activities which will be ed on in the peaceful use of atomic energy, and point out dangers which will exist if effective safeguards are not blished against the use of atomic energy for destructive (Chapters III and IV).

Our Committee has of necessity dealt with limited informa- all of which is non-secret and has been previously pubd. Two categories of information have been available, that ained in the pre-war scientific literature and that released the bombing of Hiroshima.* Much of the information he latter category has not been given in full nor have all scientific statements been confirmed by full description of rimental procedures, as is usual in scientific publication. equally true, however, that no scientific arguments would one to doubt the essential accuracy of this information. presents an orderly extension of the pre-war science of ear physics, and there are no apparent inconsistencies this pre-existing body of scientific fact.

here exists a possibility that the information with which Committee has dealt may be incomplete in another sense, ly, that major discoveries, as distinguished from technoal developments, may have been made somewhere in the l but not disclosed. Such discoveries, as well as any which be made within the next few years, might well affect aspects of the problem of control in a significant way. cally such a possibility cannot be excluded; on the other there are scientific grounds for believing that discoveries own to us, which might seriously invalidate our analysis of echnical aspects of control, are improbable.

owever that may be, this report is based on the informaavailable to us, and we believe that the statements cond in it are relevant and significant for the problem of ol, provided no major discoveries which would fundaally affect the field of atomic energy are made or have made.

hapter V deals with the relation of the possibility of e discoveries and inventions to the problem of control. ter VI summarizes our main conclusions.

nain body of information is contained in the well-known report by . Smyth, entitled "Atomic Energy for Military Purposes," 1945. ional information is contained in "A Report on the International rol of Atomic Energy" prepared for the United States' Secretary of s Committee on Atomic Energy, 1946 (Lilienthal Board Report), n the Press Release of the United States Department of State, 9 April Articles and announcements have also been published in the cal Review and in other scientific journals. Useful summaries will und in the two volumes of "Scientific Information Transmitted to Jnited Nations Atomic Energy Commission by the United States ber," dated 14 June 1946 and 10 July 1946.

CHAPTER I

THE PRODUCTION OF NUCLEAR FUELS

CHAIN REACTIONS

Atomic energy in quantities useful for peace or war comes only from a nuclear chain reaction, which, like fire, is self-propagating and releases energy in proportion to the nuclear fuel consumed. Only one material found in nature in appreciable quantities has the property of "nuclear inflammability," though two other nuclear fuels can be created through the "burning" of the naturally occurring one.* The nuclear fuel provided by nature is uranium-235, one of the isotopes in naturally-occurring uranium, but present only in the proportion of one part in one hundred and forty. At this dilution the U-235 can be burned only under the very special circumstances achieved in a structure called a primary reactor (or "pile"). Otherwise, the U-235 must be partly or completely separated from the more abundant U-238. This process of isotope separation is exceedingly difficult and requires large and elaborate installations.

Two new materials (plutonium-239 or uranium-233) can be formed from U-238 or thorium in nuclear fires burning U-235. They can be isolated by chemical methods more easily than isotopes can be separated, and will serve as nuclear fuels as well as U-235.

Thus there are three materials (U-235, Pu-239, and U-233) from which nuclear energy can be obtained by a chain reaction. The reaction may be used to deliver energy at a steady rate by incorporating the fuel materials into a reactor, a lattice structure big enough to confine and utilize the neutrons which propagate the reaction from atom to atom. Controlled burning is achieved by inserting materials to absorb enough of the neutrons to prevent a run-away explosion, but not so many as to quench the reaction.

The same fuel materials may be burned explosively in an atomic bomb. Again, the amount of material must be large enough to trap and use the neutrons. The violence of the explosion depends also on the rate of burning, so materials that absorb the neutrons must be carefully excluded.

Whereas concentrated nuclear fuel is required for bombs, a less concentrated material is sufficient for peaceful applications. This has led to the suggestion† that material be added which may make the fuel less suitable for bomb production, while maintaining its suitability for use in a controlled reactor. Such materials, which are called "denaturants," must be chosen so that they are extremely difficult to remove from the fuel material proper.

RAW MATERIALS

All the manifold applications of atomic energy depend on uranium and thorium as primary raw materials. It will be useful to trace the procurement of nuclear fuels from these raw materials. The pictorial chart (Appendix 1) and the flow chart (Appendix 2) indicate the principal stages and operations in processing uranium.

The mining and extraction of uranium ore and thorium ore is essentially a conventional operation comparable in scale with other mining operations, though not as large as many.

Uranium occurs principally in deposits of pitchblende found in Canada, the Belgian Congo and Czechoslovakia and also as carnotite and autunite in the western United States. Other deposits of uranium are found at numerout points throughout

*The terms "nuclear inflammability," "burning" and "fuel" refer to nuclear reactions which resemble ordinary combustion only in the sense that "fuel" material is used up in a self-sustaining process which releases energy. The nuclear reactions are otherwise quite unlike ordinary combustion, and do not for example, require oxygen.

†"A Report on the International Control of Atomic Energy" by the Lilienthal Board; Press Release of the United States Department of State, April 9, 1946; "Scientific Information Transmitted to United Nations Atomic Energy Commission by the United States Member," Vol. 1, p. 18.

the world. The production at the start of the war was reported as not far from a thousand tons of uranium content per year.** Perhaps the principal difficulty which bears directly on the problem of control is that uranium is derived not only from uranium ores. In many cases, uranium is derived, or might be derived, as a by-product from the ores of other metals, mainly vanadium, and also by means of retreatment of the new and old mine wastes, mill tailings, and the wastes and slags of the chemical and metallurgical plants, etc.

Thorium occurs principally in monazite sands in India, Brazil, the Dutch East Indies, Australia, and elsewhere.

It is to be expected that the search for new deposits of uranium and thorium, and the introduction of extraction methods for low grade deposits will greatly increase the potential supplies.

PROCESSES FOR THE SEPARATION OF U-235

There are two principal processes by which concentrated nuclear fuel can be produced from uranium: By the separation of the isotope U-235, and by the burning of the U-235 content of natural uranium to produce plutonium.

In the separation process, the first stage is chemical purification and the preparation of special uranium compounds, among them gaseous uranium hexafluoride.

Separation may be effected in several ways: In the gaseous diffusion method, the uranium compound in a gaseous state is forced through porous barriers. The U-235 isotope, being very slightly lighter, can get through the barrier somewhat more rapidly than U-238. By a large number of repetitions of the process it is possible to secure material which is considerably enriched in U-235. This is the process reportedly used in the very large plant at Oak Ridge, Tennessee. A related process depends on the difference in rate at which the two isotopes can move through a liquid layer between a heated wall and an adjacent cool one. This process is called thermal diffusion, and is also reported to have been used on a moderate scale at Oak Ridge. The third process, reportedly used on a large scale, is electro-magnetic separation. Intense beams consisting of molecules of a gaseous compound are projected into a magnetic field which bends their paths. The molecules containing the lighter uranium atoms, that is U-235, turn more sharply than the heavier molecules containing U-238, with the result that the isotopes are separated. There is an important difference which distinguishes this process from the others: the electro-magnetic method can yield substantially complete separation of the isotopes as compared with a very gradual enrichment by the other processes, but does it only at the price of limited production. These methods require either many stages in the process of gradual enrichment (as in the diffusion methods) or many units operating in parallel to provide significant quantities (as in the electro-magnetic method).

The output of the isotope separation plant consists of uranium compounds enriched in U-235 content to a degree determined by their intended use. That is to say, the nuclear fuel is now less dilute, and after appropriate processing, is ready for use in industrial reactors or for the production of bombs.

PROCESSES FOR THE PRODUCTION OF PLUTONIUM

Another process for the production of a pure nuclear fuel is to make plutonium from uranium. This involves a series of operations for the careful purification of the incoming uranium, the partial conversion of U-238 to plutonium in a primary reactor, the extraction and decontamination of the plutonium, and chemical and metallurgical processing to put it into usable form for reactors or bombs.

**Engineering and Mining Journal, Vol. 146, p. 80, Sept. 1945.

The chemical purification of the uranium compounds as they come from the refinery differs from usual industrial processes because of the extreme purity required. The main impurities which would absorb neutrons and thus quench the chain reaction of the reactor must be removed. The quantity of materials to be handled, and the rigid purification required (several impurities may not exceed one part in a million) combine to make the operation a difficult one. Other materials (known as "moderators") are required in the construction of the reactor, and these have also to be of extreme purity. An alternative to the production of very pure graphite or beryllium for this purpose is the production of heavy water, a difficult and large scale operation in view of the quantities needed.

The primary reactor is a very large structure containing slugs of unenriched uranium metal interspersed throughout a moderator material such as graphite. In the reactor a chain reaction is set up, which consumes some of the U-235 and produces excess neutrons. Some of these neutrons are absorbed by the U-238 and convert it to plutonium-239.

The uranium slugs, after use in the reactor, contain in addition to the unchanged uranium, plutonium and a variety of radioactive elements formed as by-products of the chain reaction. The separation of plutonium, while reasonably straightforward chemically, is a highly specialized operation because the low initial concentration of plutonium poses special problems, because the entire process must be handled by remote control to avoid danger from radiation, and because it is difficult to dispose of the radioactive by-products present with the plutonium and the uranium.

The plutonium compounds from the extraction plant are converted into metallic plutonium in a chemical and metallurgical plant. The plutonium metal from this plant is ready for use either in an industrial reactor or for the production of bombs.

SCALE OF THE INSTALLATIONS FOR PRODUCING NUCLEAR FUELS

Some of the complexities in the production of Pu-239 and uranium enriched in U-235 have been indicated in the discussion of the processes. An indication of the huge scale of the operations required for bomb production has been given in published descriptions of the plants which were constructed by the United States during the war. Some data on cost and physical dimensions taken from the United States publications has been tabulated in Appendix 3. One striking aspect is the small fraction of the total cost required for the facilities for bomb fabrication, as distinct from the production of the nuclear fuels for use in the bomb.

THE PRODUCTION OF URANIUM-233

Refined thorium compounds, after careful purification, yield thorium which can be incorporated into a primary reactor for the production of U-233. Chemical separation and the final production of U-233 in pure form require processes analogous to those for plutonium.

Naturally-occurring thorium is a single isotope and therefore no process of separation analogous to the separation of U-235 from uranium is involved. Since this isotope has not the property of "nuclear inflammability," a primary reactor using thorium alone would have no fuel to maintain the chain reaction. It can only be used therefore if a fuel material is added. In general, the available information indicates that processes involving thorium have been less thoroughly explored than those utilizing uranium. Nevertheless, in this report U-233 is included as one of the nuclear fuels, even though the avl-

information states only that it is theoretically possible to e U-233 in reactors and in bombs.

MARY

tomic energy in amounts of importance for industrial ties is obtainable only from nuclear chain reactions which, re, are self-propagating.

hree materials are known which are useful as nuclear for a self-sustaining chain reaction: only one of these 35) occurs in nature, constituting 0.7 per cent of ordinary um; the other two (Pu-239 and U-233) can be produced clear reactions from uranium and thorium, respectively.

uclear fuels may be burned at a controlled rate in a r, or in a runaway explosion as in a bomb.

he raw materials for atomic energy, uranium and thorium, in widely scattered ore deposits. Mining and processing e ores are more or less conventional operations. Pre-war ction was of the order of one thousand tons of uranium t per year.

he partial separation of U-235 from uranium to provide a grade nuclear fuel has reportedly been accomplished by us diffusion, thermal diffusion, and electro magnetic ds. All of the processes require many separate stages or and huge installations, for significant production of ntrated fuel.

utonium (Pu-239) is formed by a nuclear reaction from m, specifically, from the abundant isotope, U-238. Highly d uranium and very pure graphite can be fabricated into ary reactor which will maintain a chain reaction burning -235 fraction of the uranium, and, at the same time, this reaction to produce Pu-239 from the U-238 fraction.

e production of significant quantities of Pu-239 re- very large installations comprising highly specialized al extraction plants in addition to the primary reactors.

st data for the United States atomic bomb installations e a comparatively minor outlay for bomb fabrication as red with the cost of production facilities for U-235 u-239.

orium, as a source of nuclear fuel (U-233), differs from m in containing no "inflammable" fraction correspond- the U-235 in uranium. Thorium can, therefore, be used eactor as a source of U-233 only if nuclear fuels are ded.

CHAPTER II

UTILIZATION OF NUCLEAR FUELS

e practical applications of atomic energy all depend upon rgy, radiations, and radioactive materials resulting from chain reactions. Three fuel materials can be obtained tical quantities: U-235, Pu-239 and U-233. The char- nd scale of the equipment in which these fuels are differs for different applications and can best be con- in terms of the intended uses.

R

characteristic of a nuclear chain reaction which is most striking is the enormous quantity of energy d in the burning of comparatively small quantities of fuels. The consumption of a kilogram (about 2.2) per day of uranium-235 generates heat at the rate oximately a million kilowatts. The same amount of heat e obtained by burning about 3000 tons of coal per day, to supply the power and light for a city of about a * The use of atomic energy for the large scale genera- electric power and for industrial heating are therefore ging possibilities. Initially, at least, nuclear reactions will probably be used to generate heat which, by means of a heat exchanger, can provide steam for conventional turbo-generators producing electrical power. Many technical problems are involved in the use of atomic energy for power, but the development seems straightforward.

The large primary reactors which have been constructed for plutonium production generate a great deal of heat in the process, and might, by redesign, be used for power production. It seems probable that the size of reactors could be reduced by using concentrated fuel, although there are engineering limitations set by the rate at which heat can be removed from the structure, and the requirements for shielding personnel from the intense radiations. Published reports indicate that concrete walls more than five feet thick completely surround the large reactors at Hanford. Published estimates indicate that units for ships may be developed, but that smaller mobile units are unlikely on account of the bulk of the shielding required for the protection of personnel from the harmful effects of the radiation.

It appears likely that reactors producing large quantities of power could be built which would not contain U-238 or thorium from which new nuclear fuel would be produced. Such reactors would be consumers only of nuclear fuel which would have to be produced elsewhere.

Reactors using so-called "denatured" fuel material will be considered in Chapter III.

A possible complication in the operation of atomic power plants lies in the cumulative effects of the materials left over from the chain reaction. These comprise a variety of elements, usually called fission products, some of which may absorb neutrons to such an extent that they would reduce the efficiency of the reactor, or even stop its operation. Decontamination plants, analogous to the plants for extracting the plutonium produced in primary reactors, may therefore be needed.

Information is lacking on another important aspect of the operation of atomic power plants: This is the question of whether or not enough additional fuel can be made in a power reactor to replace the original supply of nuclear fuel being consumed. If not, the world supply of nuclear fuels is measured by the amount of U-235 present in nature, extended a few-fold by such additional quantities of Pu-239 or U-235 as are generated in the consumption of U-235. On the other hand, if the regeneration of nuclear fuels can fully replace the original materials, then all of the U-238, one hundred and forty times as plentiful as U-235, and also the world's supply of thorium which is more plentiful than uranium, constitute potential nuclear fuels.

Published information indicates that the generation of electric power from atomic energy is still in the early developmental stage, with active work in progress at Oak Ridge, Tennessee. Costs may be competitive with electric power from coal, at least in some parts of the world.

RADIATIONS

In addition to the energy generated as heat in the operation of a reactor very intense radiations, particularly gamma rays and neutrons, are released. Such radiations from radium, large X-ray units, and cyclotrons, have been used in the past for radiation therapy. The intense radiations available from reactors should make them useful for these purposes. In industrial chemistry, new processes appear possible based on the chemical actions induced by intense and penetrating radiation. In physical research, the intense beams of radiations from reactors are already proving powerful tools.

*At ten percent efficiency, the heat obtained by burning a kilogram of U-235 per day could be converted into about 100,000 kilowatts of electric power.

RADIOACTIVE ISOTOPES

In addition to radiations, the operation of a reactor produces comparatively enormous quantities of radioactive materials, approximately a kilogram of fission products for each kilogram of nuclear fuel consumed. This material is equivalent in its effects to many thousand times the same amount of radium because of the more rapid rate at which many of its constituents disintegrate. Although the fission products consist of some thirty chemical elements of medium atomic weight, radioactive isotopes of most other elements can be produced as a result of neutron absorption. Since a great many neutrons exist inside and around an operating roactor, it is easy to use them in the preparation of substantial quantities of the desired isotopes. The availability of radioactive materials in adequate quantities should permit a renewed and very vigorous attack by tracer techniques on many research problems, notably in physiology, medicine, and the mechanism of chemical reactions. Some of the fission products may possibly replace radium in cancer treatment in the future. There is in addition the possibility of new techniques based on the selective localization in malignant tissues of chemical compounds containing radioactive elements.

Comparatively small reactors will usually be adequate, and in many cases most convenient, for applications requiring radiations and radioactive isotopes, although the latter may often be obtained as by-products from large reactors operated for other purposes.

ATOMIC BOMB

The atomic bomb constitutes a highly specialized type of reactor in which the principal design requirement is that as much as possible of the nuclear fuel in the bomb shall be consumed in the very short time before the bomb bursts apart. Clearly, highly concentrated fuels are required to permit the most rapid combustion. Such materials will explode spontaneously as soon as the quantity of material in a single piece becomes large enough that the neutrons are effectively confined and utilized. The detonation of the bomb is then a matter of bringing together rapidly two or more pieces of fuel material which together exceed this critical size. Little more information than this has been released about the construction of atomic bombs, except that the critical size was predicted in 1941, within very wide limits, as more than two and less than one hundred kilograms.* In all probability, highly skilled personnel and specialized facilities are required for bomb production, but a large establishment does not appear to be necessary.

ESTIMATES OF THE AMOUNT OF POWER OR THE NUMBER OF BOMBS AVAILABLE

An estimate of the total electric power, or alternatively, of the number of bombs, which might result from the utilization of the world's production of uranium can hardly be made with any reasonable accuracy. The present production of uranium, the amount of material required for a single bomb, and the fraction of U-238 (or thorium) which can be utilized for power are all figures which are not available. However, the annual production of uranium in 1939 can be estimated at approximately one thousand tons (uranium content in ores) on the basis of data in "Engineering and Mining Journal" for September 1945.

One might, as an example, assume that one thousand tons of uranium per year are available for the production of electric power. One thousand tons of natural uranium contain about seven thousand kilograms of U-235. This amount of U-235, used in power plants having an overall efficiency of ten percent, could provide two million kilowatts of electric power for one year. If all of the uranium (and thorium) can be used, amount of power available would be several hundred mil kilowatts. In this connection, it may be of interest to qu a passage from the report of the Lilienthal Board: "We h examined in some detail . . . the technical problems of mak available heat and power on the scale of present world c sumption from controlled nuclear reactors. We see no sig cant limitations on this development, either in the availab or in the cost of the fundamental active materials."

As an alternative example, if one were to assume that thousand tons of natural uranium, containing approxima seven thousand kilograms of U-235, were available each for the making of bombs, then using the limits on critical given above as the amount of U-235 required for a bomb, number of bombs which could be produced from all of available uranium would be between seventy and thirty hundred per year.

Summary

There are three nuclear fuels (U-235, Pu-239 and U- which can be used in a sustained chain reaction yielding e mous quantities of heat, radiations, and radioactive mater The consumption of one kilogram per day of U-235 rele energy at the rate of approximately a million kilowatts, produces nearly a kilogram of radioactive materials per

The large scale production of electric power from at energy appears feasible, though still in the development st

The engineering design of a large scale power plant determine whether it requires concentrated nuclear fuels as are used for bombs or can use dilute or denatured fuel suitable for bomb manufacture; also, whether or not fu production of nuclear fuel (Pu-239 or U-233) accompa power production.

Small installations for power production appear unl for several reasons, one of which is the thick shields requ to provide protection from radiation.

The intense radiations and the substantial quantitie radioactive material available from a reactor may be expect find important applications in medicine, industrial chemi and nuclear research. The availability of radioactive iso opens the way for the intensive use of tracer techniqu chemical, physiological and medical research.

Comparatively small reactors will be adequate for mo these applications of radiations and radioactive isotopes.

The production of atomic bombs requires comparat large quantities of concentrated nuclear fuels, and corresp ingly large installations for the separation of U-235 or production of Pu-239 or U-233. Bomb manufacture is a h specialized, but hardly a large scale, operation.

Examples based on published information suggest that materials are readily available for the production of fro to 3500 bombs per year, or for the generation of ele power at a rate of two million kilowatts, and possibly times this rate.

CHAPTER III

PEACEFUL USES OF ATOMIC ENERGY AND THE BEARING ON CONTROL

INTRODUCTION

In the foregoing chapters we have given a general des tion, based on published information which is limited but we believe is reliable, of the various activities involved i production and use of nuclear fuels. It is to be expected th a peaceful state of the world, such activities will be ca on for beneficial purposes. Most of these same activitie also involved in the production of atomic weapons. Ea them involves an element of danger, since attempts ma

*Report of the National Academy of Sciences, quoted in Section 4.49 of "Atomic Energy for Military Purposes" by H. D. Smyth.

*"A Report on the International Control of Atomic Energy," Sect Chap. 3, 10th Paragraph.

to divert materials or to seize materials or installations the aim of using them for the production of atomic ons. In the following discussion, the words "danger" and gerous" will always be used with this connotation. In this ter we propose to analyze the relative importance of these ers and to explore to some extent the problem of possible uards against them.

s regards diversion it may be observed generally that the the stage at which diversion occurs, the more immediate danger arising from it because fewer subsequent opera- less time and fewer plants are then necessary to produce ons. It should also be observed that attempts to divert rials at certain stages might be so planned as to take ntage of the fact that losses in processing are normal in llurgical and chemical operations. The ease of diversion the nature of necessary safeguards varies from stage to , and each will be considered in turn. It must be stressed, ver, that all of the operations are inter-related, and the iveness of safeguards at any one stage depends in large ure on the safeguards erected at other stages.

addition to diversion there is the possibility of seizure of the fuel materials themselves or of the facilities for ucing them. This will be dealt with in the final section of hapter.

ranium and thorium are, as far as can be forseen, the naturally occurring substances from which nuclear fuel in icant quantities can be produced. Hence, these substances a fundamental and unique role in the control of atomic y.

NG OPERATIONS

Uranium and thorium are obtained from ores and de- . It is clear that, unless appropriate safeguards are taken ing that material cannot be diverted from the mining tions, attempts may be made to use it for weapons. The quences of diversion at this stage will not immediately be s since it would require considerable time and industrial ty—how much precisely would depend on the facilities ble—before weapons could be produced by clandestine tions.

considering safeguards over mining operations, the follow- ircumstances will be helpful. The mining operations, gh widely different for the rich deposits and for the rade deposits, would always be on a significant scale; take place along conventional lines and involve the ing of large quantities of ore, concentrates and tailings. uld hence appear feasible to keep track of the distribu- f any significant quantities of material from the mines. cial significance must be attached to the devising of ade- safeguards against the diversion of raw materials, since of the subsequent operations can proceed without um, or uranium and thorium.

RACTION FROM ORE-CONCENTRATES AND PRODUC- OF URANIUM AND THORIUM COMPOUNDS

xtraction and production of uranium and thorium com- s involve somewhat less bulk of material than has been lered in the previous section and may take place in plants emoved from the mines, as is the case in Canada. The sses involved are carried out in chemical plants of ordi- size and the products are still somewhat bulky. The sses normally involve losses comparable with those in industrial chemical activities. These provide an oppor- to conceal diversion by making it appear that only s losses have occurred. Therefore, only the application y close and careful safeguards would provide an adequate nce against the diversion from those plants of purified cal compounds of natural uranium or thorium for the ptitious production of explosive material for atomic ns.

PRODUCTION OF METAL AND PREPARATION FOR INSERTION IN REACTORS

Preparation of the metal from the uranium or thorium compounds also involves process losses which may be used to conceal diversion of material. The quantities of materials handled are less and the difficulties in detecting diversion are greater than those in the chemical plants discussed in the previous section. There is also the possibility of diversion during the machining and the mechanical preparation of the metal for its insertion in atomic reactors. Just as in the previous case, very careful safeguards will be needed to prevent the danger resulting from such diversion.

PRODUCTION OF NUCLEAR FUELS

Production of nuclear fuels is the crucial stage in the operations. Both separation plants for the production of uranium enriched in U-235 and the reactors and extraction plants for the production of plutonium or U-233 deliver nuclear fuel, which, under proper conditions, may be used directly for the manufacture of atomic weapons. According to the published statements available to us, the installations necessary for weapon manufacture are relatively small and the time required is relatively short if the necessary high-skilled personnel is available and the procedure is known. If therefore the strictest safeguards are not taken to prevent the material in the installations producing nuclear fuel from being diverted, the danger is extremely serious.

The technical nature of the processes involved in the production of nuclear fuels is different for the different types of plants concerned. Very large installations are required, together with highly skilled personnel and methods differing widely from usual industrial methods. The final nuclear fuel product is very small in bulk compared with the quantities of material which are processed. It is possible that even those managing such plants will not find it easy to keep track in a quantitative way of the flow of materials, in much the same way as is the case in usual industrial refinery and extraction plants. These technical facts should be borne in mind when devising the safeguards against diversion mentioned above. It is clear that such safeguards should not only reckon with the materials in the installations themselves, but also with the stocks of purified product.

REMARKS ON OPERATION OF SECONDARY REACTORS

Secondary reactors, i.e., reactors which are fed with nuclear fuel especially prepared from the products of separation plants or of primary reactors, can be designed in various ways, depending on their purpose. Secondary reactors for research and medical purposes would be of low power and could be designed so as to contain insignificant quantities of nuclear fuel. These would be unimportant as possible sources of diversion, unless present in large numbers.

Secondary reactors for the production of electric power or industrial heating would be comparable in fuel consumption to primary reactors, i.e., the reactors which are fed with natural uranium. If they regenerated fuel, they would afford opportunities for diversion similar to those afforded by large primary reactors and in order to avoid this serious danger, the same strict safeguards would be required for both. If the secondary reactors were designed so as not to regenerate fuel, safeguards would still be required in relation to the fuel supply and to the circumstance that, by redesign and rebuilding, the reactor might be converted to other purposes.

It has been suggested* that secondary reactors for electric power or industrial heating, designed so as not to regenerate explosive material, might operate on "denatured" fuel.** If so, and to the extent that this proves to be technically feasible

*See Press Release of U. S. Department of State, April 9, 1946, and "A Report on the International Control of Atomic Energy" by the Lilienthal Board, Section II, Chapter 5, Paragraph 10.
**See Chapter I.

and effective, diverted material would not be usable for weapons without further processing, involving large plants and appreciable time.

SEIZURE OF INSTALLATIONS

We have been discussing the possibilities of clandestine diversion of materials from the peaceful activities in the domain of atomic energy, but we must not overlook that with certain systems of control one would have to consider the possibility that plants or materials might be seized. This implies a danger, the seriousness of which would be greatest in the case of seizure of stocks of concentrated nuclear fuel, because from that stage weapons could be produced most quickly and in relatively small plants. Next in order of seriousness would be the seizure of plants producing nuclear fuels. A wide geographical dispersal of stocks and plants and the restriction of stocks to minimum operating levels would reduce the risk that a large quantity would be involved in a single seizure. Seizure of mines or of facilities at other early stages would only be of advantage to those desiring to make weapons if they had at their disposal a plant capable of producing nuclear fuel.

CHAPTER IV
CLANDESTINE ACTIVITIES

Clandestine manufacture of atomic weapons from nuclear fuels diverted from stocks or from the plants producing such fuels would be extremely difficult to discover because the operations involved can be carried out in comparatively small installations which could easily be concealed. This emphasizes again the importance of preventing the diversion of nuclear fuels which we have stressed in the previous chapter.

If it were sought to divert materials from earlier stages of production, or from undisclosed mines, into the production of atomic weapons, large and complicated installations would have to be clandestinely operated in order to produce the nuclear fuels. The construction of such plants involves a large scale industrial effort and many tributary activities of unusual character. On the other hand, it might be possible to break up such plants into a number of smaller units and thus make detection more difficult.

It would be difficult to carry on clandestine mining or concentrating of uranium or thorium ores if adequate knowledge of their geological occurrence were available. This is due to the large quantities of material which must be processed and the difficulty of concealing mining operations in general.

The maintenance and strengthening of the international community of scientists, the free exchange of scientific information and an increasing awareness among all scientists of one another's research activities would assist in making less likely the application of research talent to clandestine activities.

It is clear that the major assurance against clandestine activities would lie in the existence of effective safeguards applied to known peaceful activities.

CHAPTER V
FUTURE DEVELOPMENTS

Both layman and scientists are apt to believe that in the future scientific discoveries and technical inventions will be made which will bring further development of the activities in the domain of atomic energy. This raises a new question regarding control. For example, the possibility has been considered, in our discussions, that some day a method might be devised by which the separation of U-235 from natural uranium could be realized by methods less elaborate and costly than those actually used in the United States. It is clear that production of atomic weapons would thereby become easier.

There is also the possibility that some day raw materials other than uranium and thorium might be found suitable for the production of nuclear fuel. At the moment, such a possibility is highly speculative. Whatever the future may bring, those charged with responsibility for maintaining safegu[ards] on atomic energy will best be able to make necessary ada[pta]tions in these safeguards if they are intimately associated [with] and participating in new developments in the entire field.

CHAPTER VI
SUMMARY AND CONCLUSIONS

The substances uranium and thorium play a unique ro[le in] the domain of atomic energy, since as far as we know t[hey] are the only raw materials from which the nuclear fue[l re]quired for the development of atomic energy can be obta[ined]. There is an intimate relation between the activities requ[ired] for peaceful purposes and those leading to the productio[n of] atomic weapons; most of the stages which are needed for [the] former are also needed for the latter. The character of [the] different stages of the activities has been discussed in o[rder] to explore at each stage the elements of danger and to [what] extent the problem of safeguards against these dangers [...]

With respect to mining operations, which are of sp[ecial] significance as the first step in these activities, it app[ears] hopeful that safeguards are not too difficult. Particular a[tten]tion should be paid to the installations in which concentr[ated] nuclear fuel is produced since the product lends itself imm[edi]ately to the production of bombs. Unless appropriate [safe]guards are taken at each of these stages, it will be difficu[lt to] insure that no diversion of material or installations will [take] place.

With regard to the question posed by Committee 2, "wh[ether] effective control of atomic energy is possible," we do not [find] any basis in the available scientific facts for supposing [that] effective control is not technologically feasible. Whether o[r not] it is politically feasible, is not discussed or implied in this re[port], nor is there any recommendation of the particular syste[m or] systems by which effective control can be achieved.

Appendix 3—Some Relevant Data on Cost and Size of [the] Atomic Bomb Project

A. General (including construction and other activities)
Funds appropriated to June 30, 1945.....$1,950,000,[000]
Construction workers at peak....................125,0[00]
Operating personnel on August 6, 1945.........65,0[00]

B. Major Construction Costs and Indications of Size o[f In]stallations***

Installation	Expenditures in Millions of Dollars	Construction Workers at Peak	Size of Installations
Gaseous Diffusion	545	25,000	Four story [bu]ilding, ½ mile [lo]ng, ¼ mile across [c]overing 60 acr[es]
Electro-Magnetic	350	13,200	175 separa[te] buildings incl[ud]ing 9 major pr[oc]essing structure[s]
Thermal Diffusion	10.5	.....	Main building [5]2[?] x 82 ft., 7[?] f[t.] high.
Experimental Reactor at Clinton	12	3,247	Designed for [1]0[00] kilowatt cap[ac]ity
Hanford	350	45,000	600 square [mi]le site. 3 huge [re]ac[tors and che]mical separation p[l]ants; 780,000 cu. y[ds.] concrete.
Los Alamos	60	.....	......

*Press Release by Secretary of War Stimson, August 6, 1945.

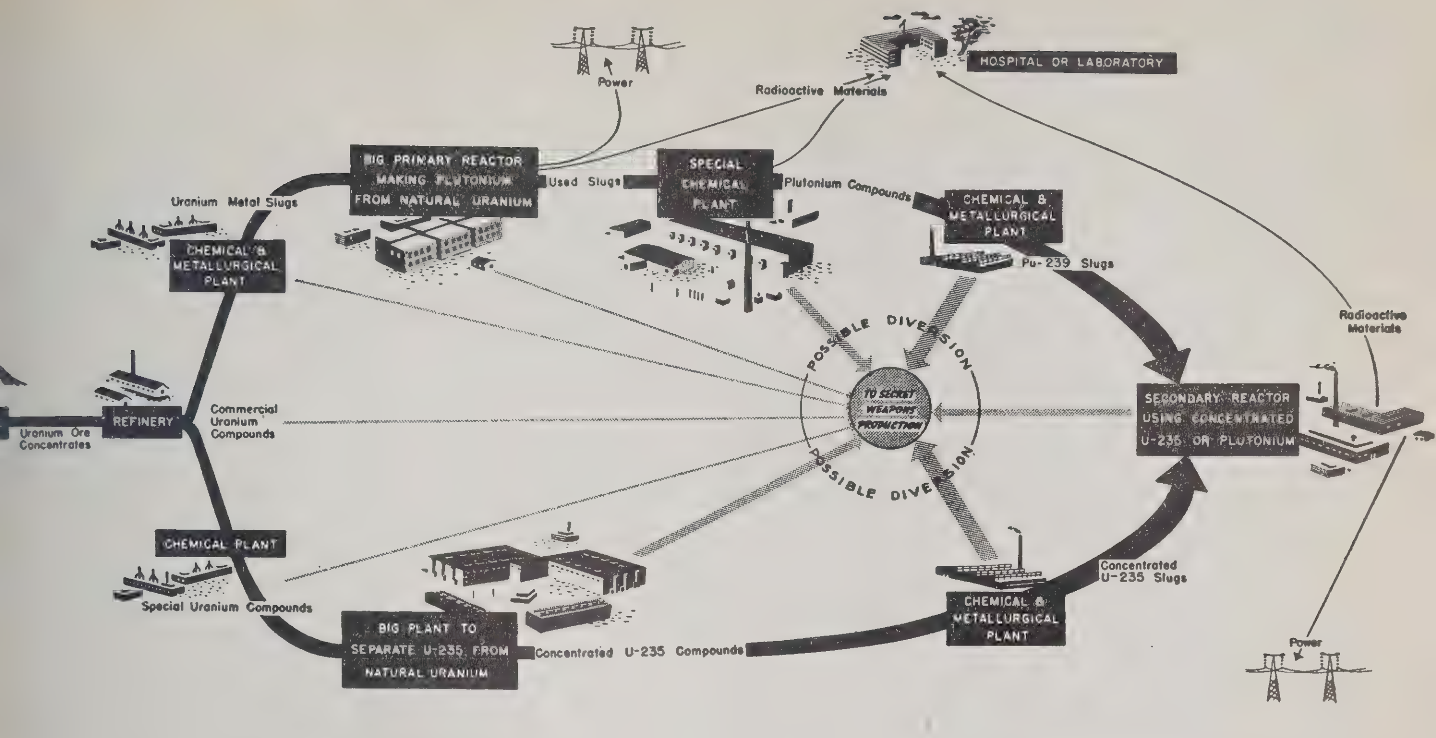
**Press Release by President Truman, August 6, 1945.

***Taken from the following publications:

"Hearings before the Special Committee on At[o]m[ic] Energy," United States Senate, November 29, 1945. Go[ve]rnment Printing Office.

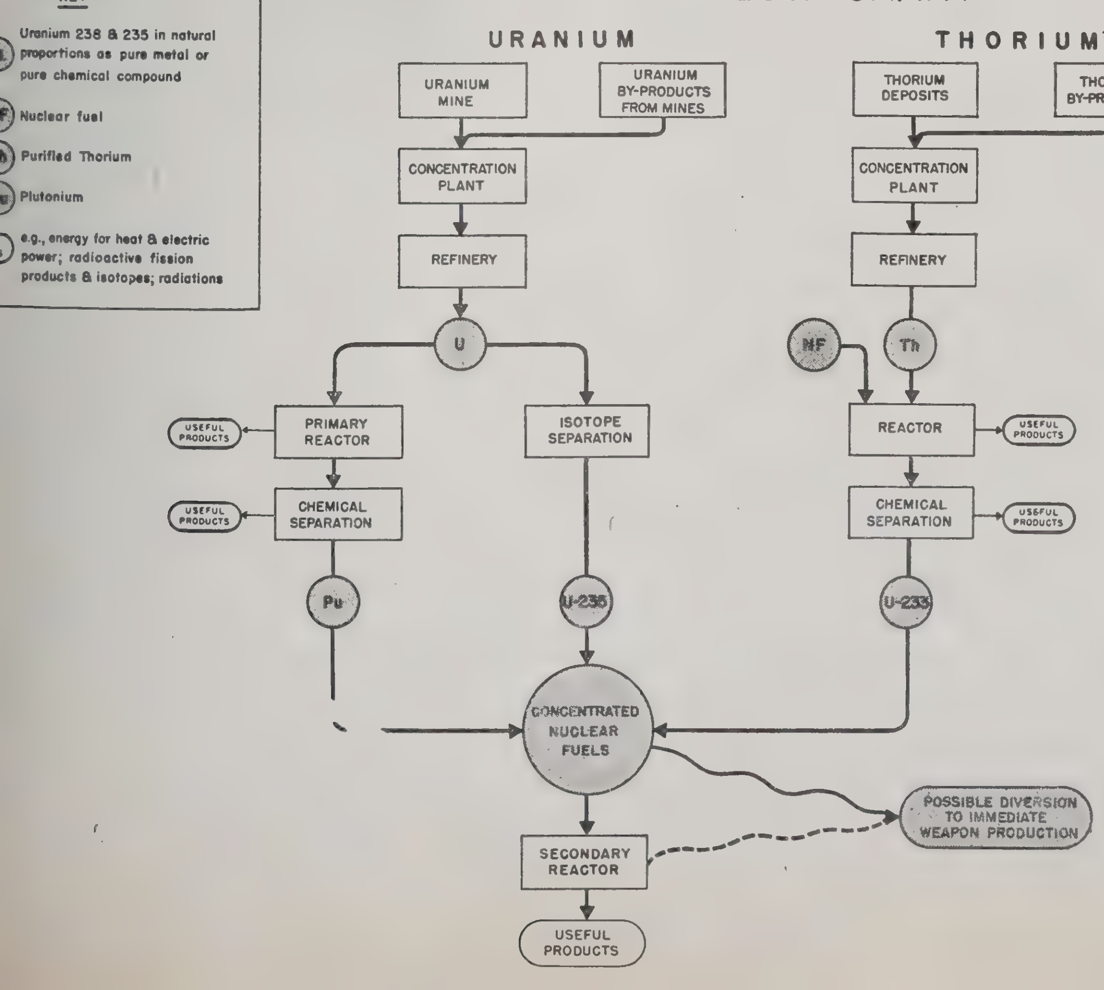
Articles in **Engineering News-Record**, December 13, [19]45

…L CHART OF THE PROCESSES USING URANIUM TO PRODUCE ATOMIC ENERGY



Note- Waste products from the various stages in the processes may be reprocessed to recover the uranium or plutonium which they contain. For simplicity, such operations have not been shown.

ATOMIC ENERGY FLOW CHART



* Note: Available information indicates utilization of thorium less thoroughly explored than that of uranium, but theoretically possible.

How Can Atomic Energy Be Controlled?

. . . . *David E. Lilienth*

Can atomic energy be so developed and so controlled that it will be used only for the advancement of human welfare and not be used for war and destruction? As we meet here tonight this is probably the world's number one question. Since June 14th a group of men meeting in New York City have been patiently seeking for an answer to this tough problem. This is the Atomic Energy Commission of the United Nations, made up of representatives of twelve countries, with Mr. Bernard Baruch the American delegate.

No answer to this question will be genuinely workable unless it is agreeable to every one of the Great Powers and all, or substantially all, the nations of the world. This is quite an order. In fact, *quite* an order. It may be something like insisting that a fellow who never in his life has broad-jumped more than ten feet must jump twenty feet. But if he feels he just *has* to jump twenty feet, if a deep chasm lies before him, and something pretty hungry is chasing him, then twenty feet is still one hell of a jump—but because he has no easy alternative, it's not impossible. Well, the world has no easy alternatives about atomic energy; none that I can see. If an answer can't be found, one that this country and Russia and the other nations fiind acceptable and workable, then we're bound to have a feverish arms race. This will not be just an atomic arms race (though atomic weapons will probably lead the list) but one clear across the board. If that happens, scientist and technical men will simply have to do what all the rest of us must then do, that is, change our whole way of living. And there wouldn't be much peace of mind while we're making the change. Instead of devoting your skills as chemists to improving the lot of men, as you would prefer to do, you, like all the rest of us—if we get into this kind of arms race—will be working like mad to find ways of scattering our cities so as to defend ourselves, and spending our energies devising ways of destroying our potential enemies. Not a pretty prospect for science or industry, or civil liberties, or nerves, or anything else.

It was scientists and technical men—prominently among them chemists—who gave the world the large-scale release of atomic energy. This is the supreme achievement to date of the scientific spirit and the scientific method. It is my own opinion that the only hope to control atomic energy and prevent its use for destruction lies in applying the scientific spirit and the scientific method to this problem. In a world thus far largely run by the ideas of politics and legalism, I freely admit that this would be something quite novel. But considering how unattractive are the alternatives, I don't believe that the twenty foot broad jump is out of the question, and I doubt if you do either.

The averting of war and the maintenance of peace are traditionally described as political problems, or as it is sometimes put, "These are matters calling for political decisions, reached and carried out by political methods." Typical political methods is domestic affairs as well as international relations are quite familiar to all of us. Their practitioners sometimes include business, labor and farm leaders, as well as politicians and statesmen—even, once in a while a scientist. And when a scientist goes in for political dogmatism, he can make a politician look scientific by comparison!

The political method, generally speaking, is based on the process of *first* deciding what the answer you and your side wants, and *then* scurrying around for evidence and arguments and public opinion and force to support the answer you started with in the first place. Political methods—I am over-simplifying a bit, but not much—are based on three procedures so far as the people are concerned as follows:

First: Tell the people what you know *they want to hear*—regardless of the facts. This gives great scope for orators, slogan-makers, and dogmatists.

Second: Tell the people what *you* want them to hear—regardless of the facts. This is the technique of the well-poisoner.

Third: Tell 'em nothing, and make 'em like it. This is an ancient art, but its modern practitioners have brought it to a new high level.

Political methods are generally quite in contrast to the scientific spirit and method. In his Novum Organum, Francis Bacon said many many years ago: "We cannot command Nature except by obeying her." The scientist, essentially a humble man, obeys Nature by honestly observing and then truthfully recording *not* what he *wants* to find, but what in truth he *does* find. The essence of the scientific method and spirit to me—a layman—is that it does not start with the answer, but with the facts, and draws its insight and its overtones from the facts.

It's not often that there is an opportunity to analyze what is called a political problem in a scientific spirit. But something of the sort did happen last winter. The product was an idea embodied in
a document published by our State
partment called "A Report on the Inte
tional Control of Atomic Energy."
proposals of that Report for the crea
of a world-wide Atomic Development
thority have since been accepted by
President, Secretary Byrnes, and Mr.
ruch and his associates as basic to
American proposals presented by
Baruch in an historic address to the
Atomic Commission and to the world

This Report represented the work
the unanimous agreement of a Boar
Consultants of five men. We were
of widely differing backgrounds and
perience. But all five of us had thi
common—we had all had responsib
for technical enterprises, and there
had grown accustomed to the method
tackling problems that are character
not of politics but of technology. Ch
Barnard, one of our associates, Presi
of the New Jersey Bell Telephone Co
ny, thinks scientifically about orga
tion. Dr. Robert Oppenheimer, a p
cist, was wartime director of the
bomb plant at Los Alamos. Dr. Ch
Thomas, a chemist and one of this S
ty's distinguished members, is direct
Monsanto's research activities, and
charge of research at the atomic en
plant at Oak Ridge. Harry Winne is
president of General Electric in ch
of engineering policy. Your speake
Chairman of TVA. So that all of us
rather extensive and responsible ex
inece in undertakings based on scie
and technical knowledge. This was in
a strange team to be asked to try to
an answer to what is classified
"political" problem.

We five locked ourselves up for
months, had the whole array of
before us, and came up with a plan
of us believed was workable. That plan
been widely discussed and is fairly
known. We urged that the people of
world agree to entrust to a world age
the Atomic Development Authority,
control and management of all activ
concerning atomic energy that are
gerous—that is, dangerous to the secu
of the world—activities that are step
the road toward the making of at
bombs. These dangerous steps begin
the raw material: uranium and thor
Under our proposed plan, factories
produce fissionable materials would
be owned and operated, not by rival
tions, but by this world cooperation f
tioning under world law and responsib
all the people.

But it is *how* our Board of Consult
went about trying to find a plan that
some ways as important as the ans

came up with. For we didn't follow typical political method of starting the answer all neatly laid out, and look around for facts and arguments support our pet notion. We didn't t, for example, by asserting that the ver was world government and then out facts that would fit that answer. did we say, "National sovereignty t in no wise be infringed," and then to squeeze out a plan that would fit dogma. No, we started somewhat as hemist might, tackling a technical lem: with the facts as he found them.

ou recall that a year ago when the ld saw for the first time the fantas- destructiveness of the atomic bomb, y Americans said, "Now, this won't this must be the last time that an nic bomb is used. The people of the ld must agree to outlaw the bomb." at was meant was that the nations ld all sign a treaty that solemnly nised that none of them would ever ecret or otherwise make these bombs use them in a war. All the nations ld devote themselves exclusively to many wonderful peaceful uses of nic energy—**for electric power, for a** on cancer and other diseases, and re- ch in a hundred fields.

y four associates and I placed the s alongside this idea of eliminating bomb by international agreement, and consequence we were forced to dis- l the idea. For these facts made it r that there was no security whatever people anywhere, no prospect of a mo- t's freedom from fear of an atomic ament race if this is all we had to r—this outlawing by international nant.

at facts? Well, fact No. 1 is this: ame materials and operations required t atomic energy to peaceful purposes daptable, virtually without change, to aking of the stuff that goes into atom- mbs. This is true through almost the course of producing atomic energy.

the light of the facts it was just polit- hoorah to talk about nations concen- g on peaceful purposes as if that for entirely different processes and ials from those used for destruction. you have produced some of this dan- s material there are ways of doctor- r denaturing it, to make it rather safe, not effective for bombs in that form; ou must *begin* with substances that ver useful for producing electric pow- for research, can just as readily be to destroy the cities of mankind. 's a fact—and a fact is a stubborn and no amount of political dogma lo anything to change a fact. (And is another thing about a scientific it pays no attention to national boun- s. There are no such things as American neutrons, say, and som edifferent kind of Russian neutrons, and British neutrons. A neutron doesn't know about boundary lines.)

These being the facts, what does an international covenant never to use atomic bombs amount to? The nations would all go through the process of signing their names to a treaty, agreeing never to make atomic bombs, agreeing that they will forbid their citizens to use fissionable materials except for peaceful purposes. But under the treaty each nation will be permitted to go on mining uranium and thorium and putting them through a plant that will produce materials that however valuable for peace are also readily suitable for a bomb.

Well, how much security—how much peace of mind would anyone get out of that? Mighty little. For as is well known the atomic bomb is a surprise weapon and a relatively cheap one. We are reliably advised that several hundred of these bombs used on a nation's cities would finish off any industrial nation of the world. The bomb was originally developed in secret and, assuming closed borders, could probably be developed by a nation in secret again. We concluded, unanimously, that if nations were rivals in the development of atomic energy materials that could be diverted rather simply from open, peaceful uses to secret, warlike purposes, an agreement by each nation to outlaw the bomb might even be worse than nothing at all. For it would create suspicion and fear as to what the other fellow is doing behind closed factory doors and in hidden and secret laboratories and bomb plants; and fear and suspicion breed wars.

Then we said to ourselves: Suppose the world agreed to join together to crack down on anyone who violated the international agreement; who despite the agreement went ahead and made and used atomic bombs. We rejected that plan, too, for we could find precious little security in a plan to punish a nation *after* it had dropped hundreds of bombs and killed millions of human beings. As for such punishment as a deterrent, the fact is that there is a premium in atomic warfare in pulling the trigger first, so that your enemy won't be able to retaliate effectively. And there is therefore a great premium on making preparations secretly while your law-abiding and trusting neighbors are depending on international agreements that say on paper that the bomb will not be used. And with that kind of creepy atmosphere to live in, in time everyone would suspect everyone else, no one would have any sense of security, and everybody would be making atomic bombs in secret. The world would not be a very happy place.

But then this was suggested: Why couldn't we have an international inspection agency, to snoop into every factory and plant to see whether nations are fulfilling their agreement not to put fissionable material into bombs? Again we looked at the facts, explored them painstakingly, and the facts forced us to conclude that a plan of inspection as a sole safeguard was quite unworkable. One of those facts was simply this: If an international inspector is to provide security against secret evasions, that inspector must know at least as much about atomic energy as the people he's supposed to watch. And there's the rub. An inspector—a high grade policeman—simply wouldn't know enough to detect a skillful evasion. This is a new field, new developments as you well know are coming along, stepping on each other's heels. Because of new knowledge the plants that are built next year will almost certainly not be like the ones we have in the Tennessee Valley at Oak Ridge or at Hanford in Washington state; and if a nation wanted to mislead the world, it could design them quite differently, so they might look rather innocent to an inspector. In a race between a nation that has scientists trying to design new kinds of plants so the international inspector wouldn't recognize them, and an army of inspectors looking for the only kind of plants they know about, which are yesterday's plants, in that kind of race the inspectors probably wouldn't have much chance. The only people who would be genuinely qualified to protect the world against secret shenanigans would be those who know how to design and operate atomic energy plants—the chemists, the physicists, and the engineers. And that is one weighty reason we urged that world security be protected by a development and operating agency manned by just such technical people, acting not for rival nations, racing each other, but for all nations and all peoples.

Well, this is the way we took one set of facts after another and explored this problem, and the things we rejected as not workable furnished a clue as to what we thought would be workable. It was these objectives, and this same method of analyzing the facts that led the President, and Mr. Baruch and his associates, to present the American proposal for such an Atomic Development Authority. There is a point in remembering that it was Woodrow Wilson who dubbed Mr. Baruch with the nickname "Dr. Facts."

The proposed Atomic Development Authority would not be a mere international detective force, but, as its proposed name implies, a development agency engaged in operations and extensive research. To provide security the ADA must *know*. Professor H. D. Smyth has said that the men on the Atomic Development Authority might well become the elite of the scientific world. "Able men," he continued, "devoted to the

(Continued on page 18)

Official Report on Biological Warfare

. . . . George W. Mer

The military strength of a nation in war depends not only on the weapons which it actually brings to bear on the enemy but also on the thoroughness with which the nation prepares for all eventualities. This basic military doctrine was followed by the United States in waging war against the Axis.

A type of warfare that might have been employed in World War II—a potential avenue of attack by our enemies—was biological warfare. Biological warfare may be defined as the use of bateria, fungi, viruses, rickettsias, and toxic agents from living organisms (as distinguised from synthetic chemicals used as gases or poisons) to produce death or disease in men, animals, or plants. This type of warfare was not unknown in World War I although it was employed only on a very limited scale. There is incontrovertible evidence, for example, that in 1915 German agents inoculated horses and cattle leaving United States ports for shipment to the Allies with disease-producing bacteria.

In the years between World War I and World War II a general interest in the possibilities of biological warfare was maintained by scientists and military men in many countries, and many came to believe that this type of warfare was possible or even probable in the future. As the interwar period drew to a close, opinion in the United States as to the possibilities of biological warfare was by no means united, but common prudence dictated to those responsible for the nation's defense that they give serious consideration to the possible dangers in this field. The counsel of those alert to the possible danger was formally brought to the attention of the War Department in the fall of 1941, whereupon Secretary Stimson promptly requested the National Academy of Sciences to appoint a committee to make a complete survey of the current situation and of future possibilities.

After careful study, this Committee—known as the WBC Committee—drew the conclusion in its report of February 1942 that biological warfare was distinctly feasible and urged that appropriate steps be taken for defense against its uses. The report stated in part:

> "The value of biological warfare will be a debatable question until it has been clearly proven or disproven by experience. The wide assumption is that any method which appears to offer advantages to a nation at war will be vigorously employed by that nation. There is but one logical course to pursue, namely, to study the possibilities of such warfare from every angle, make every preparation for reducing its effectiveness, and thereby reduce the likelihood if its use."

I

With these conclusions before him, Secretary Stimson recommended to President Roosevelt the establishment of a civilian agency to take full charge of all aspects of biological warfare. Upon the approval of the President, the War Research Service, with Mr. George W. Merck as Director was organized in the summer of 1942 and was attached to the Federal Security Agency. In the interests of efficiency, economy, and secrecy, War Research Service remained a small organization. It served primarily as a coordinating agency and drew on the facilities, personnel, and experience already existing in the Government and private institutions. Its recommendations were implemented by orders and directives issued by the various branches of the Armed Services, particularly the Medical Services of the Army and Navy and the Chemical Warfare Service of the Army. Appropriate Liaison was maintained with the Armed Services, particularly the U.S. Public Health Service, the Department of Argiculture, and the Department of the Interior. Intelligence was obtained from the Army, the Office of Naval Intelligence, the Office of Strategic Services, and Federal Bureau of Investigation; and public relations matters were handled in cooperation with the Bureau of Public Relations of the War Department, the Office of War Information, and the Office of Censorship. A committee of prominent scientists—known as the ABC committee was set up by the National Academy of Sciences and the National Research Council to advise War Research Service on its special research problems.

The exchange of information on this subject which had been inaugurated some months before with the United Kingdom and Canada was continued and provision was made for the interchange of biological warfare personnel between the three countries.

The first major task undertaken by War Research Service was the development of defensive measures against possible biological warfare attack. Measures were taken in cooperation with the Armed Services to protect the supply of water, food, and milk on the mainland; in Hawaii, the Caribbean area, particularly the Canal Zone; and finally all overseas theaters.

An extensive program for the collect of intelligence on biological warfare established, making use of the intellige collection agencies of the Armed For the OSS, and the FBI, and arrangeme were made to send specifically trai intelligence officers into operational ar to stimulate the collection of intellige on biological warfare.

The major achievement of War search Service, however, was the organi tion of a program of research and devel ment to extend the boundaries of kno edge concerning the use of pathoge agents as a weapon of war and the me of protection against possible enemy of these agents. All known pathoge agents were subjected to thorough st and screening by scientists of the high competence in their respective fields determine the possibilities of such age being used by the enemy. Those disea producing agents which seemed to o some promise were assigned to vari university and private research lab atories for intensive experimentation terms of their lethal properties, means production, and methods of protect against their use. As the program p gressed, however, it soon became cl that exhaustive investigations of biologi warfare agents, their use as weapons, means of protection against them co not be achieved without larger scale velopmental operations.

In November 1942 War Research Se ice requested the Chemical Warfare Se ice of the Army to prepare to assu responsibility for a larger scale resea and developmental program involving construction and operation of specially signed laboratories and pilot plants. site chosen for these facilities was at Ca Detrick, Frederick, Maryland, where c struction was begun in April 1943. Wh these facilities were put into operati research projects which had been develo under sponsorship of War Research Se ice were turned over to the Chemical W fare Service for further development Camp Detrick. War Research Service c tinued to exercise general supervision o the entire field and continued to spon fundamental research studies in univ sities and private institutions and to h secure scientific personnel and equipm for the Camp Detrick operations.

In December 1943, the Office of Strate Services reported to the Joint Chiefs Staff that there were some indications t the Germans might be planning to biological warfare agents. While the e dence that the Germans might use su

ts was inconclusive, there was con-able concrete information available work which had been carried on in United States, the United Kingdom, Canada that attack by biological war-agents was feasible. Accordingly, it decided in January 1944 to step up in this field, particularly in terms of protection of troops against possible y use of these weapons, and to trans-large part of the responsibility for biological warfare program to the War rtment. The complete transfer was nplished by direction of the President ne 1944 when the Chemical Warfare ce was made responsible for the pro- in the War Department with the ration of the Office of the Surgeon al on certain important defensive s. The Navy Department continued ake important contributions to the am and continued to work in close oration with the War Department s field. The research and develop-l program was greatly accelerated, gh it was directed that no biological re agents should be produced in ity without specific approval of the ary of War. In fact, no large stocks se agents have ever been accumu-

n assumption by the War Depart-of full responsibility in this field, the ary of War appointed the director ar Research Service as his special tant on Biological Warfare and shed the United States Biological re Committee, with Mr. Merck as nan, to advise him on policy matters o maintain close liaison with the and Canadian groups concerned biological warfare. This Committee omposed of representatives of the cal Warfare Service, the Office of rgeon General, U.S. Army; Bureau dicine, U.S. Navy; Bureau of Ord- U.S. Navy; Army Service Forces; Air Forces; New Developments , War Department Special Staff; nd the Office of Strategic Service. A mmittee—designated the DEF Com- —was formed by the National ny of Sciences and the National Re- Council to advise the War Depart-n the scientific aspects of the sub-

he height of its development, the Projects Division of the Chemical e Service of the Army, which car-e main responsibility for the pro-fter June of 1944, had a total per-of nearly 3900, of which some 28000 rmy personnel, nearly 1000 Navy, rly 100 civilian. The projects carried he Special Projects Division at its tallations were combined operations rmy, Navy, and civilian personnel g together in the closest coopera-tion. They worked under high pressure and the strictest secrecy. Their achievements have been most remarkable.

The first installation established by the Special Projects Division in April 1943 was the parent research and pilot center in Maryland; the second, field testing facilities established in the summer of 1943 in Mississippi; the third, a plant designed for the investigation of larger scale production acquired early in 1944 in Indiana; and the fourth, field testing facilities established in the summer of 1944 in Utah. These installations were unique in many respects requiring, as they did, special designing to meet the completely new problems under investigation. The need for great precision and rigid safety requirements created many complex engineering problems. Special equipment had to be designed, constructed and installed to handle processes never before exploited and on a scale of operation never before undertaken.

While it is not possible to reveal at this time the specific agents on which intensive work was done at these installations, the general nature of the problem and the type of information that was obtained in this field can now be told. It should be emphasized that while the main objective in all these endeavors was to develop methods for defending ourselves against possible enemy use of biological warfare agents, it was necessary to investigate offensive possibilities in order to learn what measures could be used for defense. It was equally clear that the possibility of retaliation in kind could not be disregarded in the event that such agents were used against us. Accordingly, the problems of offense and defense were closely interlinked in all the investigations conducted. This is implicit in the discussion which follows.

A wide variety of agents pathogenic for men, animals, and plants was considered. Agents selected for exhaustive investigation were made as virulent as possible, produced in specially selected culture media and under optimum conditions for growth, and tested for disease producing power on animals or plants. Intensive investigations were conducted on many aspects of this field, including studies of how well various organisms of high-disease producing power would retain their virility and how long they would remain alive under different storage conditions; biological, physical and chemical protective measures; the numbers of organisms required to produce infection; the effectiveness of antibiotics and chemo-therapeutic agents; the incubation period of various diseases; and effectiveness of certain chemicals (or coagents) when used with pathogenic agents or toxins in influencing their disease producing powers. From these and other studies has come much new information which, when published in scientific journals, will make significant contributions to the advancement of knowledge. Extensive studies of biological and chemical agents which might have been used in attacking our crops resulted in certain discoveries which will undoubtedly prove of great value to agriculture.

Studies were made of methods and means by which biological warfare agents might be employed against us. This involved not only the perfection of anti-sabotage measures—information on which was made available to appropriate civilian and military authorities—but also studies of the various types of munitions that might be employed for the dissemination of biological warfare agents. A strong intelligence program was instituted which operated very effectively in all theaters of operation with the result that a thorough knowledge of German activities in this field was obtained. Similar investigations of Japanese activities are now being conducted. When these investigations are completed it will be possible to evaluate fully the work carried on in this field by our enemies. All evidence to date indicates that the Axis powers were behind the United States, the United Kingdom, and Canada in their work on biological warfare. It is known also that after early 1942 Germany obtained no information concerning the United States activity in biological warfare, and that no serious leaks of information on this subject occurred in this country. The intelligent and whole-hearted cooperation of the press and radio of the nation, working in conjunction with the Office of Censorship, helped very materially in this regard.

In all work on biological warfare carried on in the United States, extreme care was taken to protect the participating personnel from infection. Many new techniques were devised to prevent infection and proved highly successful. Hospitals and dispensaries were maintained at all installations, staffed with both Army and Navy medical personnel and well equipped to treat accidental exposure to infection. As the result of the extraordinary precautions taken, there were only sixty cases of proven infection and these were caused by accidental exposure to virulent biological warfare agents which required treatment. Fifty-two of these recovered completely; of the eight cases remaining, all are recovering satisfactorily. There were, in addition to the sixty proven cases, 159 accidental exposures to agents of unknown concentrations. All but one of these received prompt treatment and did not develop any infection. In one instance, the individual did not report exposure, de-

veloped the disease, but recovered after treatment.

Obviously, none of these cases were brought about intentionally, and were not, therefore, "controlled" experiments, but in any event certain valuable information was obtained from their treatment, particularly with regard to new antibiotics, chemotherapeutic agents, and immunizing procedures, which, but for these cases of accidental infection, could otherwise have been tested only on animals. Considering the variety of pathogenic agents handled, the scale of operations employed, and the relatively large number of people involved, the safety record of our biological warfare program is truly remarkable.

The activities of the United States in the field of biological warfare, undertaken under the goad of necessity and aimed primarily toward securing for this nation and its troops in the field adequate protection against the possible use by our enemies of biological warfare agents, were carried on with that teamwork characterized by cooperative effort in wartime. The branches of the Army and Navy, many civilian scientists, university and private research institutions, and several Departments of the Government all worked together to the common end. This was a matter of great urgency, and many of the problems were unique and most complex. The objective was attained; adequate defenses against a potentially dangerous method of warfare were devised, the possibility of surprise from this quarter was forestalled. Apart from the military objectives attained, however, much information of greater and lasting value for human welfare was obtained. Unique facilities were established for research and experimentation on pathogenic agents on a scale never before possible. These facilities will be of inestimable value to future military and civilian biological investigations. In general terms, these were some of the more important accomplishments of the program:

1. Development of methods and facilities for the mass production of microorganisms and their products.

2. Development of methods for the rapid and accurate detection of minute quantities of disease-producing agents.

3. Significant contributions to knowledge of the control of airborne disease—producing agents.

4. Production and isolation, for the first time, of a crystalline bacterial toxin, which has opened the way for the preparation of a more highly purified immunizing toxoid.

5. Development and production of an effective toxoid in sufficient quantities to protect large scale operations should this be necessary.

6. Significant contributions to knowledge concerning the development of immunity in human beings and animals against certain infectious diseases.

7. Important advances in the treatment of certain infectious diseases of human beings and animals, and in the development of effective protective clothing and equipment.

8. Development of laboratory animal propagation and maintenance facilities to supply the tremendous number of approved strains of experimental animals required for investigations.

9. Applications of special photographic techniques to the study of airborne microorganisms and the safety of laboratory procedures.

10. Information on the effects of more than 1000 different chemical agents on living plants.

11. Studies of the production and control of certain diseases of plants.

Steps are being taken to permit the release of such technical papers and reports by those who have been engaged in this field as may be published without endangering the national security. It is important that this may be done soon, for much of the information developed in the course of this undertaking will be of great value to public health, agriculture, industry, and the fundamental sciences.

III

While it is true that biological warfare is still in the realm of theory rather than fact, in the sense that it has not actually been used, the military findings of groups engaged in similar work in the United Kingdom and Canada have shown that this type of warfare cannot be discounted by those of this nation who are concerned with the national security. Our endeavors during the war provided means of defending the nation against biological warfare in terms of its presently known potentialities, and explored means of retaliation which might have been used, had such a course been necessary. Although remarkable achievements can be recorded, the metes and bounds of this type of warfare have by no means been completely measured. Work in this field, born of the necessity of war, cannot be ignored in time of peace; it must be continued on a sufficient scale to provide an adequate defense.

It is important to note that, unlike the development of the atomic bomb and other secret weapons during the war, the development of agents for biological warfare is possible in many countries, large and small, without vast expenditures of money or the construction of huge production facilities. It is clear that the development of biological warfare could very well proceed in many countries, perhaps under the guise of legitmate medical or bateriological research.

In whatever deliberations that [illegible] place concerning the implementation [illegible] lasting peace in the world, the poten[illegible] ities of biological warfare cannot se[illegible] be ignored.

How Can Atomic Energy Be Controlled?—

(Continued from page 15)

traditional ideals of science, and men e[illegible] to contribute to the increase and dissem[illegible] tion of knowledge regardless of nat[illegible] boundaries, will be glad to join this gro[illegible] And this high caliber of talent woul[illegible] essential to world security so that [illegible] agency entrusted with control would [illegible] as much as anyone in the world about [illegible] possibilities.

There is an even more important th[illegible] perhaps less obvious reason why the ag[illegible] should be more than a policing force. "[illegible] genuinely effective for security," my [illegible] ciates and I stated in our Report, "the [illegible] must be one that is not wholly neg[illegible] suppressive, and police-like . . . (It) [illegible] be one that will tend to develop the [illegible] ficial possibilities of atomic energy an[illegible] courage the growth of fundamental k[illegible] edge, stirring the constructive and i[illegible] native impulses of men rather than m[illegible] concentrating on the defensive and [illegible] tive. It should, in short, be a plan [illegible] looks to the promise of man's future [illegible] being as well as to his security."

Some people have objected to our pro[illegible] because it doesn't guarantee an end to [illegible] That's a valid criticism, for what w[illegible] out to do was to find a way to preven[illegible] surprise use of atomic weapons. Eve[illegible] would be profoundly happy if so[illegible] would come up with a workable schem[illegible] would eliminate all war with one st[illegible] but I don't anticipate that that's the [illegible] it will happen. That's the goal; it mu[illegible] of course; but to get to that goal [illegible] got a long way to go and much to [illegible] Perhaps the best way to get there [illegible] start with the most urgent problem [illegible] that would seem to be atomic weapo[illegible] we can't take this first step what cha[illegible] there for the full-blown world gover[illegible] some people believe is essential, or a[illegible] to all war? My own guess is, not [illegible]

But if in this one field of atomic e[illegible] the people of the world can develop [illegible] tem of world law and a world operatin[illegible] control agency, by following the fact[illegible] disregarding political dogma, then pe[illegible] all of us can tackle the next worst pr[illegible] in the same way, and get that behi[illegible] and on to the next, and in this way [illegible] to work together, begin to figure o[illegible] problems on the basis of facts, in [illegible] thing of the spirit that scientists go [illegible] their problems, and really look forw[illegible] a generation of great progress and se[illegible] of real development not only phys[illegible] but morally and spiritually.

he Atomic Bomb and the Prevention of War

. . . . **Bertrand Russell**

r. Russell in transmitting this manu- ot wrote us an interesting note indi- ng that it had been refused by five rican periodicals of wide circulation. has appeared in the English journal EMIC.) In offering it to the Bulletin hich he reads "with interest and at- on"—Mr. Russell trusted us to cut f necessary without distorting his s.

e publish the article in full in the be- that Mr. Russell automatically de- es an American audience and that Bulletin reader is sufficiently discrimi- ng to profit from articles which he not necessarily endorse.

IMPACT OF ATOMIC WAR

e atomic bomb has set a problem to kind which must be solved if any able existence is to be possible for the n race. The problem is that of abolish- arge-scale war, not at some distant e date, but quickly, before there has time for another vast conflict to k out.

the next great war were to occur n the next two or three years, it l probably lead to a quick victory he United States and its allies, since her Power would have atomic bombs. f there is no war in the near future, will have been time for Russia to facture atomic bombs—and not only a, but many other nations, great mall. It must be assumed that bombs soon become much cheaper and much destructive than those dropped on apanese. In addition to bombs there possibility of spraying large regions radioactive substances which will ex- nate all life in their neighborhood. a little carelessness, life on this t may be made impossible.

s to be expected that, if war comes, ll begin with a surprise attack in yle of Pearl Harbor. The aggressor hope for a knock-out blow so severe make retaliation impossible. If Great n were the target, it is probable that hope would be realized, for Great in is peculiarly vulnerable to atomic , owing to the smallness of its area he density of its population. It is expected that during the first day vo London, Glasgow, and all the centers of population will be wiped industrial production will be para- and about half the inhabitants will . To carry on the war after such a would be totally impossible.

situation will be slightly less catas- c, though still appalling, if the at- s directed against the United States. e first 24 hours, New York, Washington, Chicago, and all the main centers of population will cease to exist; President and Congress will have undergone a diabolic alchemy, and a considerable percentage of the inhabitants of the United States, including most of those who are important in industry, will perish. The bomb will be borne by rockets, and it will be a matter of guess-work to infer what government is responsible. Some of the survivors will clamour for peace at any price, while others will proclaim that they would rather die than submit to so foul a blow. If the nation's store of atomic bombs has been succesfully safeguarded, probably the resisters will prevail; there will be fierce revenge, many nations will be drawn in, and destruction will continue until disorganization makes the further manufacture of atomic bombs impossible. If one side succeeds first in this aim, it may consider that it has won a victory, but it will be a "victory" far more disastrous to the "victor" than any defeat known to history.

THE COST OF "PREPAREDNESS"

Let us consider for a moment what will be involved in the meantime in safeguarding atomic bombs and rockets. It will be necessary, to keep their location secret, which will mean virtually a prison camp for those who work in connection with them. It will involve a constant suspicion of treachery, leading to a prohibition of foreign travel for all but the most highly trusted public servants, as already in Russia. It will involve a complete cessation of freedom for all scientific workers whose activities have any bearing on the warlike utilization of atomic energy. It will require apparatus and crews always ready, day and night, to retaliate upon whoever is considered the most probable enemy, as soon as there is any report of an atomic bomb being dropped. These crews must be told that, in a crisis, they are not to wait for orders, since the statesmen and the higher command will probably be wiped out. In the atmosphere of mutual suspicion thus generated diplomats will meet to discuss such important questions as who is to have the oil of Persia or the tin of Malaya; as they talk, they will be wondering which side will get in first with its Pearl Harbor. Sooner or later, nerves will give way, and the explosion will occur.

If utter and complete disaster is to be avoided, there must never again be a great war, unless it occurs within the next few years. Is it possible to establish a system which will secure this result before we suffer the penalty of our folly and our cleverness?

THE PERMANENT PREVENTION OF WAR

It is entirely clear that there is only one way in which great wars can be permanently prevented, and that is the establishment of an international government with a monopoly of serious armed force. When I speak of an international government, I mean one that really governs, not an amiable façade like the League of Nations, or a pretentious sham like the United Nations under its present constitution. An international government, if it is to be able to preserve peace, must have the only atomic bombs, the only plant for producing them, the only air force, the only battleships, and, generally, whatever is necessary to make it irresistible. Its atomic staff, its air squadrons, the crews of its battleships, and its infantry regiments must each severally be composed of men of many different nations; there must be no possibility of the development of national feeling in any unit larger than a company. Every member of the international armed force should be carefully trained in loyalty to the international government.

The international authority must have a monopoly of uranium, and of whatever other raw material may hereafter be found suitable for the manufacture of atomic bombs. It must have a large army of inspectors who must have the right to enter any factory without notice; any attempt to interfere with them or to obstruct their work must be treated as a *casus belli.* They must be provided with aeroplanes enabling them to discover whether secret plants are being established in empty regions near either Pole or in the middle of large deserts.

The monopoly of armed force is the most necessary attribute of the international government, but it will, of course, have to exercise various governmental functions. It will have to decide all disputes between different nations, and will have to possess the right to revise treaties. It will have to be bound by its constitution to intervene by force of arms against any nation that refuses to submit to the arbitration. Given its monopoly of armed force, such intervention will be seldom necessary and quickly successful. I will not stay to consider what further powers the international government might profitably possess, since those that I have mentioned would suffice to prevent serious wars.

PEACE THROUGH POWER ALLIANCES

There is one other method by which, in theory, the peace of the world could be secured, and that is the supremacy of one nation or of one closely allied group of nations. By this method Rome secured the peace of the Mediterranean area for several centuries. America at this moment, if it were bellicose and imperialistic, could compel the rest of the world to disarm, and establish a world-wide monopoly of American armed forces. But the country has no wish for such enterprises, and in a few years the opportunity will be gone. In the near future, a world war, however terrible, would probably end in American victory without the destruction of civilization in the Western hemisphere, and American victory would no doubt lead to a world government under the hegemony of the United States —a result which, for my part, I should welcome with enthusiasm.

But if, as seems more likely, there is no world war until Russia has an adequate supply of atomic bombs, plans for world peace will have to reckon with Russia and America as roughly equal Powers, and an international government, if it is to be established before the outbreak of an utterly disastrous war, will have to be created by agreement rather than by force.

Short of actual force, however, the government of the United States, with the support of Great Britain and a number of other Powers, could do a great deal towards the creation of an international government. An alliance could be formed, consisting in the first place of all North and South America, the British Commonwealth, France, Belgium, Holland, Scandinavia, and Spain (after dealing with Franco). This alliance should proclaim certain international purposes, and declare its willingness to be joined by any Power that subscribed to those purposes. There should be both military and economic inducements to join the alliance: military, in that the alliance as a whole would undertake the defense of all its members; economic, in a lower tariff for trade within the alliance than for trade with countries outside it, and also in advantages as regards loans and access to raw materials. There should be a gradual increase in the closeness of the alliance, and a continually greater amalgamation of military resources. Every possible effort should be made to induce Russia to become a member the alliance. In this way international government might grow up gradually.

PEACE THROUGH THE UN

There is, however, a strong body of opinion which favors a different course. Instead of trying to create a strong organization which would at first not include Russia, those who favor this opinion prefer a weak organization, the United Nations, of which Russia is already a member. If this is to be anything more than a weak evasion of the problem, it must be supplemented by a vigorous attempt to alter the constitution of the United Nations. At present, there is machinery for preventing Finland from attacking Russia, but none for preventing Russia from attacking Finland. There is, in fact, nothing to hinder a Great Power from waging aggressive war, whether against another Great Power or against a small defenseless neighbor. The only wars prevented by the organization of the United Nations are those that are not at all likely to occur.

If the United Nations Organization is to serve any useful purpose, three successive reforms are necessary. First, the veto of the Great Powers must be abolished, and majorities must be declared competent to decide on all questions that come before the organization: second, the contingents of the various Powers to the armed forces of the organization must be increased until they become stronger than any national armed forces; third, the contingents, instead of remaining national blocks, must be distributed so that no considerable unit retains any national feeling or national cohesion. When all these things have been done, but not before, the United Nations Organization may become a means of averting great wars.

All this may seem Utopian, and perhaps it is. Politicians and diplomats are trained in evasion and ambiguity; most of them will prefer to offer a sham which can be obtained with little effort rather than an effective measure that is sure to encounter strenuous opposition, but they will dress up the sham so skillfully that many people will be deceived. Those to whom the survival of mankind is more important than victory in the next election must strive to enlighten the public while there is still time, and perhaps we can succeed.

The men of science, to whom politics is an alien art, find themselves suddenly faced with great responsibilities which they do not know how to fulfill. By their discoveries they have put immense powers, for good or evil, into the hands of ordinary men who have not the training required for a rapid change in age-old mental habits. The political world is complex, and understanding nuclei is no help in understanding diplomacy. But the same intelligence which enabled physicists to understand nuclei will enable them to understand politics, provided they realize that the problems are complex and that slap-dash solutions will not work.

"THE BIG TWO"

Although people speak of the "Big Three" or the "Big Five", there are in fact two Powers, the United States and the U.S.S.R., which far surpass all others in strength. Other Powers are, some of them, satellites of the one, some of the other, some hesitantly neutral. All other important Powers, including Great Britain, are, I think, prepared to acquiesce in the limitations of national sovereignty that are called for by the atomic bomb. This is not owing to any superior wisdom, but because their national sovereignty is already at the mercy of the Big Two. (E.g. the British have to submit to Bretton Woods and the Chinese, unless vigorously supported by America, to the loss of Port Arthur and the South Manchurian Railway.) The problem of establishing an international authority is therefore a problem of which the solution rests with America and Russia.

Russia, since it is a dictatorship in which public opinion has no free means of expression, can only be dealt with on the governmental level. Stalin and Molotov, or their successors, will have to be persuaded that it is to the national interest of Russia to permit the creation of an effective international government. I do not think the necessary persuasion can be effected except by governments, especially the government of the United States. Nor do I think that the persuasion can be effected by arguments of principle. The only possible way, in my opinion, is by a mixture of cajolery and threat, making it plain to the Soviet authorities that refusal will entail disaster, while acceptance will not.

THE EDUCATIONAL TASK IN AMERICA

Persuasion in the United States, where there is freedom of propaganda, is a different matter. If things do not go as we might wish, the fault is usually not with the politicians, though they get the blame; the fault is with public opinion, to which the politicians, as democrats, quite legitimately give way. What is needed is an immense campaign of public education. The average American voter, very naturally, is annoyed by the way in which the follies of Europe and Asia compel America to go to war; in his emotions he is an isolationist, even when hard facts have convinced his reason that isolationism is no longer practicable. He wishes the Atlantic were still as wide as in Washington's day, and is

to forget the arguments against isonism whenever business is prosper-

o meet this difficulty it is necessary to g home, not only to administrators Congressmen, but to the average Amer- citizen, the dangers to which, with- few years, America will be exposed, the impossibility of warding off the gers except by a partial surrender overeignty. The first reaction of nine le out of ten will be to urge that erica should have more bombs than one else, so that an attack by any r nation would be obviously folly. fallacy in this point of view must nade plain to all and sundry. It must pointed out that America has al- y been involved in two world wars direct result of the fear of being lved: both in 1914 and in 1939 Ger- y would not have gone to war if rica had pronounced in advance nst neutrality. It must be made clear the same thing would inevitably pen again: a war between Russia China, or between Russia and Great ain, would be sure to involve the ed States. Next, the utter disaster n atomic war must be made clear, it must be demonstrated that there o defense against a surprise attack. lly it must be proved that there is hope in Kellogg Pacts, declarations niversal good will, alliances, or paper ibitions of the use of atomic bombs. This must be set forth in speech and writing throughout the length and dth of the land, by men having no ve except public spirit and the hope the world in which they have lived still exist in their children's time.

such a campaign is to succeed, it ires three things: a definite pro- mme, an organization, and the en- iasm of a great moral crusade. With- this last nothing can be achieved, for ugh, from a purely rational point iew, self-preservation is a sufficient ve for all that needs to be done, preservation alone will not overcome bstacles of rational thinking that are nted by ancient habits of hatred, cion, and envy. We shall have to ze that what injures a foreign na- does not necessarily benefit our own. hall have to learn to feel a little un- ortable if we wallow in plenty while ons die of hunger and cold. We shall to feel that domination brings less iness than cooperation, and that mu- hostility, which was always wicked, now become suicidal folly.

t I would not have it thought that campaign should be mainly negative, or based entirely upon an appeal to fear. The appeal to fear has its function, especially in providing an initial shock which may compel attention. But the ultimate and most valid appeal should be to hope. There is no need of great wars, no need of the horror of populations reduced to utter misery, harried and starved in a vast campaign of retribution. There is no reason why poverty and want should continue anywhere in the world. There is no reason why national education, in almost every country, should encourage false beliefs which promote warlike feeling. There is no reason why increase in the efficiency of production should be used, not to raise the standard of life, but to increase the proportion of human effort that is devoted to mutual extermination. All these evils depend for their continued existence upon war, and the national hostilities bred by the fear of war. If once the fear of war were removed, the whole human race could quickly attain a level of happiness and well-being surpassing that of the most fortunate in any earlier time. If the atomic bomb shocks the nations into acquiescence in a system making great wars impossible, it will have been one of the greatest boons ever conferred by science.

But it is time to return from these high hopes to the very different world in which for the present we have to live. I shall assume that such a campaign as I have indicated has had a considerable measure of success in America and Great Britain. (It will encounter less opposition in Great Britain, because the British realize that Great Britain will be wiped out in the next great war, if it occurs.) It remains to ask ourselves what, in that case, we ought to do about Russia.

ANGLO-AMERICAN POLICY TOWARDS RUSSIA

The policy most likely to lead to peace is not one of unadulterated pacifism. A complete pacifist might say: "Peace with Russia can always be preserved by yielding to every Russian demand." This is the policy of appeasement, pursued, with disastrous results, by the British and French Governments in the years before the war that is now ended. I myself supported this policy on pacifist grounds, but I now hold that I was mistaken. Such a policy encourages continually greater demands on the part of the Power to be appeased, until at last some demand is made which is felt to be intolerable, and the whole trend is suddenly reversed. It is not by giving the appearance of cowardice or unworthy submission that the peace of the world can be secured.

In dealing with the Soviet Government, what is most needed is *definiteness*. The American and British governments should state what issues they consider vital, and on other issues they should allow Russia a free hand. Within this framework they should be as conciliatory as possible. They should make it clear that genuine international cooperation is what they most desire. But although peace should be their goal, they should not let it appear that they are for peace at any price. At a certain stage, when their plan for an international government are ripe, they should offer them to the world, and enlist the greatest possible amount of support; I think they should offer them through the medium of the United Nations. If Russia acquiesced willingly, all would be well. If not, it would be necessary to bring pressure to bear, even to the extent of risking war, for in that case it is pretty certain that Russia would agree. If Russia does not agree to join in forming an international government, there will be war sooner or later; it is therefore wise to use any degree of pressure that may be necessary. But pressure should not be applied until every possible conciliatory approach has been tried and has failed. I have little doubt that such a policy, vigorously pursued, would in the end secure Russian acquiescence.

THE CONSEQUENCES OF FAILURE

The issue is the most momentous with which mankind has ever been faced. If it is not solved, war will exterminate the civilized portion of mankind, except for such remnants as may have been engaged in exploring the Antarctic Continent or investigating the theology of Tibetan Lamas. These will be too few to reestablish civilized communities. If mankind, in the course of a millenium or two, slowly climbs back to its present intellectual level, it is to be presumed that it will again inflict a similar catastrophe upon itself. If any of the things that we value are to survive, the problem must be solved. How it can be solved is clear; the difficulty is to persuade the human race to acquiesce in its own survival. I cannot believe that this task is impossible.

The Medical Uses of Atomic Energy . . . . . C. P. Rhoa

What can we accomplish today in the application of radioactive isotopes in the treatment of disease? My feeling is that, at this moment, isotopes of only two elements have been proved to be therapeutically useful: radioactive isotopes of iodine and phosphorus.

Curiously enough, each one of these two elements has been shown to be useful in the treatment of one non-cancerous medical disorder and one form of cancer. That is, radioactive iodine has been proved to be effective in the treatment of a disorder of the thyroid gland associated with over-functioning of that gland and poisoning of the body. Radioactive iodine is capable of restraining this overactivity, bringing functions to normal and so relieving the patient of symptoms. The application of iodine in the treatment of cancer of the thyroid gland I will discuss in a moment. In the case of phosphorus, there is a very real use in treating a non-cancerous disorder of the blood-forming tissues, a disorder marked also by over-functioning, which can be restrained by the use of radioactive phosphorus. There is also a set of cancerous disorders of blood formation known as leukemia, which again can be restrained in certain specific instances.

I will discuss the matter in that order, the two medical applications of radioactive phosphorus.

The work with iodine began in a rather quiet way in the late 1930's, and one of the earliest studies was that of Hertz and his associates in Boston, who prepared iodine by the exposure of ethyl-iodide to radium mixed with beryllium. The activated iodine was injected into rabbits. Then the various organs of the recipient animal were removed, minced, spread in a mush on a plate, and exposed to standard detection techniques. In this way it was possible to show that, as had been expected, the thyroid gland picked up, when normal, about 80 times as much iodine as was picked up by any other normal tissue. This result is still valid. Furthermore, the fact was shown that, if the thyroid gland was stimulated by such factors as pregnancy or else by the administration of materials which lead to over-activity of this gland, the pick-up of iodine might reach a level of several hundred times that found in normal tissue.

I don't wish to oversimplify, but perhaps it is appropriate to explain that the thyroid gland is located in the neck and had the very important function of selecting iodine from the blood stream and of converting the iodine to a compound known as thyroxin, which is active in maintaining a specified rate of —the rate of oxidation of live tissues— oxidation of the tissues. When an excess of thyroxin is formed, the metabolic rate increases to a point where severe symptoms of poisoning and death may result. This disease can be controlled in many instances by the removal of the source of the poison, the thyroid gland or a large part of the gland. This involves a procedure which is at best troublesome and unpleasant; at worst hazardous—possibly to a great degree. Hence, any procedure which allows the control of over-thyroid function without surgical operation is a matter of great importance to medicine.

The experiments of Hertz showed not only that the active thyroid gland picked up more iodine than the normal thyroid gland, but also that the curve of pick-up was quite different. Furthermore, certain different types of overactivity could be elucidated specifically by examining the rate of uptake of iodine in these beautiful experiments. Once these points had been clear, the next logical step was to use iodine, prepared by the cyclotron method and then becoming available, to study the uptake of iodine by the thyroid gland of human beings.

A good deal of very complex work was involved. Precise indexes had to be established by which the pick-up per unit of tissue could be settled. This was done and then studies were made on man. The earliest set of reports or one of the earliest was by Hamilton and Soley of the University of California; a report by Hertz appeared about the same time.

Hamilton reported on 22 patients in 1939, 22 patients with overactivity of the thyroid gland treated by radioactive iodine and studied for the extent of the pick-up of this active element by the thyroid tissue. He made a very important observation, later confirmed by Hertz, that the iodine actually goes to form the toxic material which is made by this gland. In other words, the iodine takes part in the natural metabolic processes of this important organ; this fact is a notable contribution to our knowledge.

Furthermore, Hamilton reported on two patients who had cancer of the thyroid gland. The evidence suggested that the cancer shared the ability of the tissues from which it sprang to pick up iodine. The findings, of course, led to the possibilities that one had (a) a method for controlling overactivity of the gland and (b) a method of controlling, perhaps, cancer of the gland.

I will deal with overactivity first. In the spring of this year, two papers appeared from the Boston investigators, one by Hertz and Roberts and the other by Chapman and Evans, who picked up the work when Hertz left for the war. These papers deal with the results of the study of some 50 patients with thyroid overactivity. Detailed studies were made, the precise retention of iodine by the gland was established, and the precise degree of control of gland activity was made clear and factual. It is possible to say that today, on the basis of well established data, this disorder may be controlled in about 80 percent of the patients by using radioactive iodine. This is a very important advance.

I am sorry to say that one precaution was not observed, as far as I am aware. I am not certain that sufficient experiments have been done to establish the limits of safety of the use of radioactive iodine in the treatment of thyroid disorders. One must always recall that in dealing with materials of this type, sufficient energy may be liberated over a sufficiently long period to make cancer occur. It is a very curious anomaly that the agents with which we deal in treating cancer are also under certain circumstances able to cause cancer. I am very hopeful that studies will be made now on an extensive scale to establish the amount of radiation delivered by iodine to the thyroid gland which can be tolerated without the induction of changes which may become cancer in that organ.

In short, one can control hyperthyroidism by the use of radioactive iodine. There is a little debate about what dose is desirable and a little debate upon the duration of control, but I think for the purpose of a general statement one can assume that the case is proved and control is possible.

The use of radioactive iodine in the treatment of thyroid cancer is a much more difficult matter, and I think I am justified in discussing for a moment what we know about the nature of cancer. Recall that cancer is the growth from a normal cell of a distinctly abnormal form which shares in appearance, structure and functions certain of the characteristics of the cells from which it springs but which differs somewhat from the parent structure. These differences can be established in a variety of ways and they may be of greater or lesser degree. We have no really precise means for measuring how different the function of the cancer cell are from its maternal parent.

Thyroid cancer is more than a single disease. This disorder, marked by wild, uncontrolled overgrowth of thyroid

d cells, may take a variety of forms ernable under the microscope. Mr. nelli and Dr. Foote of Memorial Hos-, among others, have made careful ies of the quantitative pick-up of ra-ctive iodine by the several forms of er of the thyroid gland, and also by in non-cancerous or benign tumors hat organ. They have done a great to correlate the cellular picture of oid cancer with its ability to pick odine. It is a very interesting thing as the cancer cells become more and unlike their parent cells, they simul-ously lose to a greater and greater ee the ability to share with the parent the function of selecting iodine and entrating it in their bodies. In other s, the more malignant, the more vi-, the more widespread and destruc-the cancer is, the less, by and large, s ability to pick iodine out of the l stream and to concentrate it in the lar structure.

happens that some years ago at the efiore Hospital here in New York two nts were studied who had cancer of hyroid gland and had very extensive ized deposits of the cancer tissue in us parts of the body far removed the parent tissue—what we call stases. Of these two patients, one had the thyroid gland, the site of the nal cancer, removed surgically but had manifestations of an overactiv-of the thyroid. This was clear evi-, of course, that the extensions of cancer shared the functions possessed he parent gland of manufacturing oxin, the toxic product formed by the l normally. This suggested that, since oxin contains iodine, the cancer stasis or localized deposits would up radioactive iodine and perhaps in ient quantities to allow control of growth.

deed, in this instance, when iodine given as a tracer and a Geiger coun-passed over the body, deposits of can-were detected which had not been alized by ordinary x-ray methods. v me to point out that this was a unusual case and a beautiful one experimental study. I believe that Marinelli, Dr. Leiter, Dr. Seidlin, and associates made a very distinguished ribution. It was possible to show that conventional method of supressing thyroid activity in this patient also ressed the activity of the localized minated deposits of the thyroid can-and further that the iodine was picked n good concentration by these local-deposits. Then finally the crucial ex-nent was made under Mr. Marinelli's tion: the patient was treated with oactive iodine and a pronounced ther-tic effect was obtained. Indeed, now years later, the patient still appears to be under good control. The tumor is still there but, as far as one can tell, it is no longer active. A very dramatic and a very exciting case. However, this point must be made, thyroid cancer takes many forms. Certainly not more than 15 per-cent of all thyroid cancers, a rare desease in the first place, has been shown to pick up appreciable amounts of radioactive iodine. One form, and a rather unusual form, can be depended upon to pick up iodine. The more malignant and destruc-ive forms tend to pick up to a lesser and lesser degree as the inasiveness increases.

I personally cannot feel hopeful that we will have by radioactive iodine, straight inorganic iodine, an attack on a very large percentage of thyroid cancers. The beautiful work done on the single case I have discussed with you and the excitement associated with any new meth-od of treatment have tended to obscure the fact that only a very small percentage of all thyroid cancers pick up radioactive iodine at all and only a very small frac-tion of those pick up amounts adequate to allow one to expect to control the di-sease.

However, I don't wish to appear over-pessimistic. I'd like to point out that we have only scratched the surface of this problem. Efforts should be undertaken to incorporate radioactive iodine in organic compounds that may be picked up to a greater extent by the abnormal, cancer-ous tissue.

To summarize, radioactive iodine is use-ful in the treatment of hyperthyroidism, but I think that we do not yet have adequate data on the hazards. Therefore, until we have more information, I will preserve a conservative position in pre-dicting the extent of the future use of that material. In the treatment of thyroid cancer, only a small percentage of the cancers pick up iodine at all and only a small fraction of those pick up enough to allow us to expect a therapeutic effect of the radioactive element. But still the first bridge has been crossed; one can control specific examples of the disease.

I will next discuss radioactive phos-phorus. Early in the work with isotopes, Dr. John Lawrence of the University of California and others began to explore the possibility that phosphorus could be used to measure the rate of growth or the rate of chemical turnover of normal and cancer cells. This of course was thought possible because phosphorus is an active participant in the metabolic processes.

Dr. Lawrence published originally a very dramatic experiment involving the use of radioactive phosphorus in the study of leukemia in mice. I'd like to point out that leukemia is a term which includes a number of sub-groups. It is a cancer of the blood-forming tissues but, since there are several different types of blood-form-ing tissues, there are several different types of leukemia. They are all fatal, but they vary in their clinical manifesta-tions and in their response to therapy.

The results obtained by Dr. Lawrence proved that the lymph glands, the glands in one's neck that swell when one has a sore throat, if they were the site of can-cer (leukemia), picked up more radio-active phosphorus than did the normal glands. That led to an elaborate series of studies on animals with leukemia of various forms and then on human be-ings with leukemia to establish how great a difference in pick-up existed between normal tissue and tissue which had be-come cancerous (leukemic). It was learned that the pick-up of phosphorus was dependent really upon a number of factors. One factor is the amount of phos-phorus which normally is deposited in tissue. For example, bone, which is made up very largely of calcium phosphate, will in time deposit a large amount of radioactive phosphorus, but it is turned over very slowly. This leads to a second factor, the metabolic turnover of phos-phorus, and that is very important be-cause rapidly growing cells use in their metabolic activity much more phosphorus than do less actively growing cells.

Cancer cells, by and large, are very rapidly growing cells, and so the very early observations gave very promising results. They indicated clearly that can-cer cells in general tended to pick up more phosphorus per cell than did analo-gous normal cells. I regret to say that these early experiments in my opinion were not adequately controlled, because normal tissue was not compared with can-cer tissue having the same rate of growth. The cancer tissue was compared with normal tissue of a lesser rate of growth. Since this factor of growth rate was not adequately controlled, the early figures were more hopeful than the later informa-tion warrants. But, in any event, the fact was clear that phosphorus was picked up by leukemia tissue. The pick-up depended on the chemical activity of the cells, the activity in general correlated with the rate of growth, and the cancer in general grows more rapidly than normal tissue; hence there was more phosphorus in the cancer cells than in the normal ones. This was particularly true of the cancer cells of the blood-forming tissues; the bone marrow, the spleen, and the lymph glands.

These facts promptly led, of course, to experiments designed to cure cancer of blood-forming tissue by the use of radioactive phosphorus. I don't want to bore you by a long dissertation on medical terminology, but you should understand

that there are two types of cancer of blood-forming tissue. One type concerns a group of white blood cells, normally the defensive cells of the blood stream, formed principally in the bone marrow. A cancer of these cells can occur, known as myelogenous leukemia. The cells then grow without restraint, infiltrate all tissues of the body, and lead to the death of the individual affected. These cancer cells share with the normal form the property of picking up large amounts of radioactive phosphorus or, of course, phosphorus of any type and are somewhat more active in this function. In this way, a high concentration of radioactive phosphorus can be set up in the cancer cell, which thereby poisons itself and commits suicide very handily for us. So far, some 150 patients have been treated for this disease with radioactive phosphorus.

To sum up the results, it may be stated that rather uniformly the growth of the cancer cells can be restrained to some extent, the symptoms of the patient can be lessened, but life probably is not prolonged. Certainly life is not prolonged by more than 2 or 3 months. The phosphorus is somewhat better from the point of view of the patient than is the use of conventional x-ray treatment, because there is less radiation sickness involved, but a real hazard is associated with the use of phosphorus. We are dealing here with an element with a half life of 14 days, and it is not possible to predict precisely how sensitive are the cancer cells or exactly how much phosphorus they will pick up. It is almost impossible to predict percisely how much normal blood-forming tissue is present in the body. Therefore, it is hard to arrive at a dose which is just right to control the cancer cells and will avoid serious or perhap fatal damage to the normal blood-forming tissues of the body. For that reason, a tendency in most institutions is to discard the use of phosphorus and to stick to conventional x-ray as being somewhat safer and more predictable in its results and attended by less hazards to the patient, even though it does cause some illness in the course of treatment.

The second form of leukemia, known as lymphatic leukemia, is a cancer of another type of white blood cells. It also kills uniformly and somewhat more quickly than does the myelogenous form. It is of particular concern to us all because it is a form which frequently effects children. There have been extensive studies on the use of radioactive phosphorus in the treatment of lymphatic leukemia, and I regret to say that the results are not promising.

About 160 patients have been studied carefully, and the results have been summarized. These experiments have been made in a number of clinics, all very good, and it is quite apparent that the results are rather unsatisfactory. Of all the patients with the chronic form of lymphatic leukemia only about 50 percent show any measurable benefit from this procedure. The other 50 percent are not benefited at all. Furthermore, the benefit exerted is at best transient since there is little or no prolongation of life. And, finally, there is a factor of hazard. Radioactive phosphorus, once it is in the body, can't be removed. The precise sensitivity of the normal tissue, which picks up phosphorus almost as well as the cancer tissue, cannot be predicted. The tendency is to abandon the use of radioactive phosphorus and to revert to the more conventional x-ray treatment. Even though the x-ray treatment requires cumbersome equipment and is associated with some illness on the part of the patient, it is somewhat more controllable.

I think that, until we have better compounds of radioactive phosphorus than those now used, the treatment of chronic lymphatic leukemia does not promise dramatic results in the near future. In the treatment of acute lymphatic leukemia, there is no good result whatever and it is distinctly hazardous.

To summarize briefly, there are two forms of leukemia; in myelogenous leukemia, some relief can be obtained, life is not prolonged, and there is little advantage in the use of phosphorus; in lymphatic leukemia, there is no advantage in phosphorus, life is not prolonged, and the hazard is real. I am not optimistic about the future of the use of inorganic radioactive phosphorus in the treatment of cancer of the blood-forming tissues.

There is another disorder of blood-forming tissues which is not a cancer and which is known as polycythemia. In this condition, the formation of red-blood cells is abnormally rapid. It is not a fatal disease. It is a metabolic abnormality attended by serious symptoms, great disability, and eventual complications which may lead to death. Here the picture is quite different from that of leukemia. In the case of polycythemia, radioactive phosphorus is an excellent therapeutic agent. Doses in the range of 2 to 4 millicuries result in the disappearance of symptoms, which lasts for up to two years without further treatment. The patient is enormously relieved. There is objective evidence of improvement and, by every point of view, in treating this disorder the use of radioactive phosphorus is the method of choice.

Let me sum up these four conditions. The two non-cancerous conditions—hyperthyroidism and polycythemia—are ac-
sible today to treatment, the first
radioactive iodine and the second
radioactive phosphorus. The two car
ous conditions—thyroid cancer and
cer of blood-forming tissues—are
proved to be very accessible to cure
control by the use of radioactive io
in the first case or of radioactive p
phorus in the second case.

Now what does the future hold?

To have expected inorganic element
be picked up so selectively and con
trated so adequately by cancer tissu
compared to normal tissue was a
optimistic hope. I am not surprised
we are somewhat disappointed, but
have a vast field before us. We are
ginning to study the selective pick-up
cancer of a vast variety of organic
pounds which can be synthesized in
laboratorie of organic chemistry to
tain radioactive isotopes of a variety
elements. I am very hopeful—that s
ling discoveries will be made in the y
to come—not next year or the year a
but in five, ten or fifteen years.

I can give you examples of what
of thing is in progress. It is possible
cancer tissue contains somewhat di
ent proportions of amino acids than
normal tissue. Experiments are under
to synthesize amino acids containing
dioactive elements. It could be hope
one cares to be very optimistic, that
could in this way lead into the cance
tissue, by its affinity for certain org
constituents, quantities of radioactive
terials which would lead to an auto-in
ication and death of the cancer tis
Similarly, much cancer occurs in org
which are under the control of the
hormones, the breast and the uteru
women and the prostrate gland in
These organs depend for their very e
ence an compounds of known chem
constitution. It is believed that they se
tively concentrate these compounds
hormones when they are administe
Efforts are now under way to synthe
in the laboratory sex hormones cont
ing radioactive elements.

Finally, and this must not be o
looked there is the tremendous funda
tal work which will be done in a stud
the basic biochemistry of the body by
use of radioactive tracer elements. I
there has been far too much emphasi
the direct therapeutic application of
isotopes now in existence and far too
tle emphasis on the enormous deve
ments out of which will come a new
of knowledge of the fundamental ch
ical processes of the body through
use of tracer elements which atomic
ergy provides. Through that study a
ta opens up which is really most ins
ing to think about.

omic Research in France

. . . . *L. Kowarski*

French Atomic Energy Authority mmissariat a l'Energie Atomique") reated early in 1946 by a special law lgated by the Provisional Govern- Roughly equivalent to an Under- aryship of State, it has wide powers l with all aspects of research, dev- ent, property and management with- e field of fissile materials and nu- energy. It is headed by a Commis- onsisting of a High Commissioner resent: Professor Frederic Joliot, College de France), three scientfic issioners (Professors Pierre Auger, Ecole Normale Superieure, Irene Joliot, of the University of Paris Francis Perrin, of the College de e) and a Commissioner representing al Defence (General Dassault, co- tor of defence research). Some of ommission's meetings are held un- e chairmanship of the Prime Minis- d a permanent representation of the nment is secured by the presence of dministrator-Delegate (at present: Dautry, former Minister of Supply ell-known administrator of French al Railways).

overwhelming predominance of the n element among those responsible omic development in France is well ping with the aims of this develop- According to the official statement on June 25th by the French dele- t the UN Atomic Energy Commis- France has no intention of manufac- atomic weapons. The intentions prompt the French Government to ake and sponsor atomic research e listed as follows:

To enable French science, pure and d, to bring her original contribu- wards a worldwide development of knowledge and its peaceful appli- ;

To create a pool of French scientists ngineers conversant with the basic and notions in the field of nuclear reactions and ready to make use of ew processes, wherever discovered henever disclosed;

To provide physical, chemical, bio- and medical laboratories with new ncluding home-made tracers and ra- apeutic substances;

promote industrial uses of the ener- ived from nuclear reactions, espe- n the coal-importing regions of the Union.

ng the initial stages educational ndamental research activities are o play a predominant role and, ac- gly, an important part of the Au- 's activity is at present exercised h the established research centers such as the Laboratory of Nuclear Chemistry (College de France), Radium Institute, etc. In order to facilitate and supplement the contribution of these older institutions, a cluster of workshops, testing laboratories and designing offices has been built up and is already in operation in a disused military fort in the immediate vicinity of Paris. The next step, at present in its preparatory stage, will be the establishment (on a site totalling several hundred acres in the outer suburban region south of Paris) of a full-scale new research center comprising at least one experimental pile, a radiochemical plant, accelerating equipment and facilities for applying radiations and radioactive substances in various branches of scientific research. Contracts have been concluded with industrial firms in France and abroad for the supply of specific raw materials and, at the same time, wide survey of resources in fissile elements is being conducted in the territories of the French Union, both metropolitan and overseas.

The Authority started its work with an initial endowment of 500 million francs ($4,200,000) to be followed by new grants according to the needs and pace of its development. Current figures concerning the rate of expenditure and size of the staff are hardly significant in the present stage of quick initial growth.

In appraising France's chances of playing a significant part in the worldwide search for atomic knowledge and of developing industrial nucleonics on her own territory, we have to bear in mind the handicaps resulting from the situation during the War and from the necessity to direct a very predominant part of the national effort towards the immediate needs of reconstruction. On the credit side, however, we may list a well-developed tradition of nuclear science, especially in the field of radiochemistry, the familiarity with many relevant industrial processes, such as non-ferrous metallurgy and electrochemistry and finally the facts that research on uranium fission was partly initiated in France, and that French scientists took an active part in the Allied research project all through the war years (as related in the British White Paper). Both because of these past links and in view of her intentions concerning the future, France has no isolationist tendencies in the field of atomic development. Her action with regard to such questions as secrecy and security against atomic weapons will be conditioned by her own views as well as by her past, present and future international obligations.

SUMMARY OF COUNCIL SESSIONS OF THE FEDERATION OF AMERICAN SCIENTISTS, N. Y. City, Sept. 22, 23, 1946

In a two day session, the Council of the F.A.S. elected officers and voted to:

Set up an International Information Center, probably in New York.

Study detailed plans for establishing an educational organization. Institute specialized study projects on topics related to atomic energy.

Invite persons outside the natural sciences to membership on the Advisory Panel of F.A.S.

The Sunday morning session afforded an opportunity for discussion with a group including Professor Blackett, President of the British Association of Scientific Workers; Drs. F. Joliot-Curie, and L. Kowarski of the French delegation to the U.N. Atomic Energy Commission; Dr. J. R. Oppenheimer; Drs. Szilard, Urey, and Weisskopf, of the Emergency Committee of Atomic Scientists; and Capt. Raymond Blackburn, M.P., who has taken an active interest in the political problems of atomic energy in Britain.

Comments on the negotiations in the U.N. Commission revealed agreement on the fundamentals of the problem, although difference of opinion exists on the implications of the U.S. Proposals, the feasibility of discussing the functions of an A.D.A. apart from the political aspects of its establishment, and the possible effect of the U.S. ceasing to manufacture bombs.

Boorse reported that the British atomic scientists have asked that the F.A.S. take the initiative in establishing an International Information Center, probably in New York. J. A. Simpson, H. A. Boorse, H. H. Goldsmith, and W. A. Higinbotham were named as a committee to make recommendations on carrying out this project.

The need for intensive studies by experts of special problems related to the program of the Federation was formally recognized. David Hawkins was authorized to name two others to serve with him as a commission to conduct such studies through the cooperation of appropriate specialists. Two topics were assigned for immediate attention: Present trends in the natural sciences; and the implication of the idea of preventive war.

In order to clarify its official structure, the F.A.S. voted to distinguish between the duties of Chairman of the Administrative Committee and those of supervising the central office by creating the title of Exec. Secy. for the latter function. For a similar reason, it combined the offices of Secy. Treas. R. R. Wilson was elected Chairman of the Administrative Committee; W. A. Higinbotham, Exec. Secy.; and J. H. Rush, Secy.-Treas.

— J. H. Rush

The Pattern of an Armaments Race—

Part II–An Analysis of Nationalism . . . . Gregory Bate

The whole of the foregoing discussion of armaments races is based upon the assumption that the population of the world is subdivided into a series of self-maximating units, called nations. It is clear that any blurring of the line of this subdivision, any union of these units under some central agency, or any steps which will diminish the self-maximating tendencies of the units will also diminish the possibility of international war as we understand it. It is also clear that any context which promotes the expression of international rivalry—not only the armaments race itself but also most of the competitive contexts of international negotiation—will increase the possibility of war.

There is, therefore, a series of matters which require careful analysis. Of these, we will here consider only two: 1. The mechanics of national self-maximation; 2. The mechanisms of central authority which are to be found in various parts of the world. These we shall examine to determine the conditions under which such authority is stable, so that we may make recommendations for the organization of a still higher authority which shall also be stable.

THE MECHANICS OF NATIONAL SELF-MAXIMATION

Here again, as in the armaments races, we have to deal with regenerative or "vicious" circles of causes and effects. The simplest of such circles was pointed out long ago by Malthus and consists in this, that the offspring which are the *effects* of procreation in one generation become the *causes* of procreation in the next. From this circular system it follows that if the offspring are consistently more numerous than the generation preceding, the population will show geometric increase. Such circumstances as the extreme limitation of the food supply or the complex anxieties of occidental middle-class life may diminish the ratio of increase even below unity, but it is important to note that starvation will diminish man's happiness long before it diminishes his health, and that his general health is affected before there is any appreciable diminution in his procreative power. He will thus, in most cases, struggle to increase his supplies long before he begins to diminish his reproductive activities. If, in such a case, there is an available organizational structure, such as is provided by the national units, this structure will be used as a rallying point in the struggle and will itself take on the characteristics of a self-maximating entity.

This vicious circle, pointed out by Malthus, is however by no means the only and probably not even the immediate root of the self-maximating tendencies of national units. Not only the whole population but also the separate individuals or small aggregations of individuals may be self-maximating. Considering man simply as a mammal, we could not predict this, because our merely mammalian needs are satiable. The individual mammal needs oxygen, food, water, sleep, sexual satisfaction, etc. but each of these needs is limited by the animal's physiological capacity and by the time at its disposal. It cannot consume more than a certain amount of any of these commodities in the twenty-four hours. Man, however, has become conditioned in most (but not all) of the cultures of the world to desire certain other things and to desire these with what appears to be infinite appetite. Necessarily the commodities so desired are non-physiological and such that the time spent on their enjoyment is not proportionate to the amount of the commodity enjoyed. To admire oneself, to be admired, to be obeyed, to be feared, even to be hated—these can be enjoyed with minimum consumption of time, and many of us in many cultures have acquired insatiable appetites for one or more of these "goods". These appetites, in turn, may often take on a crudely economic form because real goods are instrumental to their satisfaction. It is, however, very important to remember that these insatiable needs, even when they take on an economic form, are not simple expressions of mammalian nature but are based upon acquired appetites the derivation of which is a social and psychological problem, not a problem of economics.

That these insatiable appetites, once implanted, should affect the policy of the national unit and contribute to it the characteristics of insatiability is not surprising, though much detailed analysis is still needed to map the exact causal routes through which this occurs in each national unit with its specific system of personal incentives and "values". It is, however, worth noting that in those cultures which build up the group or the national unit to be a symbol of the disciplining parent —i.e. confer upon the national symbol some of the authority of conscience—the participating individual is *ipso facto* made free from almost all ethical limitations when he avails himself of the instrumentality of the group or nation in the pursuit of his own insatiable desires. And also we may note that the individuals feel that they themselves share in the authority and prestige which is im to be acquired by the national unit.

As to how these insatiable ap are implanted in the individuals, w as yet very poor information—n believe, which is sufficiently ex enable us to answer questions abo differences which undoubtedly exi tween one occidental culture and an We know enough, however, to say th appetites themselves are comple varied, and that they are largely mined during early childhood. Her two of the outstanding patterns mentioned.

a. In a very large number of cas appetite for power or prestige is f upon a need for psychological securi reassurance which goes back to childhood experience. Prestige power are seen as instrumental curity but, in reality, acquisition of instruments brings at most only a of the longed for security. The indi may for a little while achieve som like security at a given level of the system but, having achieved this, he up the ladder and arrives at a for which he may be unfitted and in he meets his old insecurity in a more urgent form. The individual i kept striving endlessly and neuro for instruments which can be acquir which do not accomplish their purp

b. In a great many cases, the indi is conditioned to value not a *state* of or prestige, but an *increase*. A mech designed to perceive the direction change need only give "*plus*" or " answers and therefore is always s than the mechanism required to m a steady state. This generalization with even greater force to human p tion owing to such phenomena as accommodation and olfactory "fa and undoubtedly it applies also to ou ception of more complex stimuli. Th seeking for power or prestige or se is often not a mere seeking for tain status but rather a seeking upward change in status. Only actual upward gradient can we b that we are not going down; a state we are unable—or too lazy—t mate with sufficient sureness to our anxieties. Now, there are many ties in the world which present different picture, societies in which of status is limited by the character ture of the individuals who lear childhood to feel not less but mo xiety when they perceive that their is shifting towards the unfamilia often express our disapproval of su

s, labelling them as "static". We, lves, however, show extreme anxiety there is any suggestion of altering tructure of the social ladder. The es in our own status which result our own climbing may give us a of reassurance, but the total sys- within which we climb must, by all s, remain static. And the phenomena tionalism are an integral part of that system. The national unit itself is strumentality by which we achieve nblance of prestige, security and and to which, by using it, we trans- ir own insatiabilities.

S TOWARDS DIMINUTION
ATIONALISM

m this broad analysis, we may draw n conclusions relevant to nationalism atomic age:

t is evident that the insatiability of al units, so long as these remain ate, can be mitigated only by a very c revision of incentives and values individual level within each nation. rst become susceptible to these in- es and build an appreciation of these into our characters at an early age. cer future generations so that they ot be similarly prone to seek neuro- for instruments which promise but confer security, will require a care- adjustment of the character-form- ontexts of childhood. But we our- , though we may agree that such changes are necessary, can scarce- cute them. We, after all, have been ioned to accept the major premises own competitive and anxious cul- nd this acceptance is implicit in our f voice whenever we comment fa- y or unfavorably upon our children's and whenever we try to influence behavior. We are caught in a hen- stem, but anthropology can at least this much comfort—it can assure t our problem is more soluble than f the hen. The color of her chicks ermined by her genes and those of cock, whereas the character of our en is in large measure determined ironmental experience.

here are also, a number of steps could be taken to modify incentives adults, and some hope that these cations might be built into the cul- hich is transmitted to the children. ially it is a matter of making each dual maximally proud to do well or which he is most fitted, ensuring e shall have a chance at some occu- for which he is fitted and pre- g him from being promoted to some job because he happens to do well he is. The psychological techniques e assessment of character and skill day good enough to save government ndustry millions of dollars by the tion of square pegs in round holes nese techniques will no doubt profoundly alter our patterns of incentive. The same techniques could also be used to intercept the more neurotic individuals before they reach the policy-making positions which, inevitably, they seek.

3. It is clear that every national unit should have an agency which will continuously evaluate social changes, examining them for their psychological and economic implications. Such an agency would see each institution and each new trend and major context of life as a character-forming context. It would ask: What are the effects of this institution going to be? What experiences will the participating individuals meet in their dealings with this institution? And how will these experiences affect their character and future behavior? Mass communications, civilian food habits and life in the armed services were subjected to this sort of analysis during the war, and no doubt in time we shall do this sort of thing for every important element of the culture—from baby carriages to the impact of commercial advertising. It is essential that our mammoth communities be so structured that they, by means of their governments, have optimum facilities for adaptive behavior.

4. At a later stage it will be necessary to solve the problem of those national insatiabilities which are derived from population growth. For this undertaking we probably have time in hand and can afford slowly to build up the necessary world climate of opinion, insights and incentive systems. For the present it is clear that none of the three major powers in the world is motivated toward conflict by pressure of population and it appears that the recurrent famines of the world are due more to deficiencies in distribution than to a permanent world shortage. It is possible also that industrial applications of atomic energy may further postpone the pinch of population pressure.

ESTABLISHING A STABLE
WORLD ORGANIZATION

As anthropologists we know that small human communities can exist without a centralized authority. There is, however, a very clear limit to the size of such communities. Even with a food supply which will permit large aggregations of people and with enemies in the offing (always a great help to social integration), the chiefless communities of New Guinea can only hold together about one thousand individuals. Above this size, the community will split, one half going off and starting a new settlement. And today with the prohibition of headhunting and resulting lack of fear, communities even as small as three hundred are liable to split. Also, specific constructive activities may be used to integrate rather large numbers of people. Among some of the American Indian tribes it was possible to integrate for a short period of time as many as two thousand individuals around such undertakings as the buffalo hunt.

For the integration of larger aggregates, we know that a centralized coordinating agency is necessary and we know a good deal about the conditions which must be fulfilled if such an agency is to maintain its effective status. By extension, we may be sure that the stability of any central agency which will coordinate the various national subdivisions of the world will be subject to analogous conditions. Therefore it is worthwhile to examine the various types of central mechanism which exist in various types of human community in order to obtain insight into these conditions.

At the outset, we can say at once that all such central coordinating agencies must have *multiple* functions. We may be tempted to guess that in their origin these various types of leaders, coordinating committees, religious officials and so forth were established to meet some single recognized need, such as the organization of war, the enhancement of popular vanity, the entertainment of the people, the petty advantage of the leaders or of some specific faction, the making or the enforcement of law, or the organization of food getting. But, however this may be, the fact remains that all stable coordinating agencies in existing societies have actually multiple functions. Their relationship to the people can be analyzed as a complex give-and-take of services, such that the chieftain or committee is a real organic part of the community.

This great complex of acts is also a system of *communications*—it constitutes for all the individuals concerned a stream of experience such that they consciously or unconsciously absorb the major premises and attitudes upon which the stability of the whole system depends. Our own election system, for example, is a series of acts whereby the elected candidate is made dependent upon the electorate but it is also for the electorate not only a source of entertainment but also an advertising of the importance of government. Candidates A and B may criticise each other as much as they please so long as the basic premise upon which their structures are based is the importance and seriousness of government. Even the electoral process serves multiple functions.

We are today faced with a single major need—for the elimination of war between national units—and we therefore attempt baldly to construct a central organization which will do this and, almost, this alone. We argue that "it must have teeth" and we see our dreamed of structure as functionally analogous to a police force—not as analogous to a government. The anthropologist sees at once that such a structure will not be able to maintain itself.

It will not establish a give-and-take of services and communications such that the participant individuals will learn to live in terms of the major premise that there is a world organization of which all are part.

It is therefore essential that the world authority shall be implemented with multiple functions so contrived that a maximum number of individuals all over the world shall be brought into the orbit of activity in reference to it and from such activity shall learn and appreciate its importance. That it should have large scale propagandic and educational functions goes without saying—a budget about equal to our expenditure on atomic development would be a reasonable beginning—but beyond this it should be able to build up its prestige with the multitudinous devices that every government uses to demonstrate that all have a vested interest in its continuance and success, devices ranging from flags and parades to postal services and epidemic control. It, and not the national units, should pay the salaries of the delegates to its assemblies, and we may begin to feel hopeful when its civilian employees run into the hundreds of thousands, all of them with a vested interest in its continuance. In this connection, it is clearly very desirable that many agencies like the proposed Atomic Development Authority be set up under the central aegis.

It is also important to consider the order in which various types of function shall be vested in the world authority. If we thing merely in terms of police power, there is a danger that we may assign to the agency this function before it has received those other powers which are necessary to enable it to maintain itself. We know that with only police power no such agency can be stable. Even on a small intra-national scale, purely police organizations become so unpopular as to be unable to maintain themselves and it is exceedingly unlikely that, once having police power and incurring the resulting odium, the world authority would be given those additional powers which it needs in order to live. On the other hand, once having the power to make its continuance desired, the world authority could easily convince the national units that the other terms of the charter should be implemented by addition of police power. Not only the final structure but also the steps of it sevolution must conform to the conditions which limit its stability.

In conclusion, let me emphasize again that these problems are susceptible to anthropological and other types of scientific analysis; that *only* by awareness of the circumstances and processes involved can we be influenced towards adaptive courses in the short span of time at our disposal.

The penalty for failure to accomplish the necessary analyses or for failure to make our conclusions available to the peoples and policy-makers of the world is vast. It is the spread of destruction, famine, disease and chaos to the whole human species. It is the sudden plunge from organized life into social entropy. In the past, with groping awareness, man has slowly evolved complex and highly differentiated social systems. When his awareness of the effects of his own acts was insufficient, a single tribe or a single empire has rotted away but other cultures and communities have survived. Today we face the possibility that the whole result of this long evolution may be destroyed. Today also, we are beginning to achieve higher orders of awareness, more rapid and more critical techniques for analyzing social processes. Insofar as our awareness is improved, it is possible—but not certain—that we may be able to plan and carry out those steps which will save us all.

Gregory Bateson is an important British-American anthropologist. He is at present the Secretary of the Institute for Intercultural Studies.

Clinton Laboratories Training Program

The Clinton Laboratories, which are operated by the Monsanto Chemical Company under contract with the Manhattan District, are planning to conduct a combined training and research program during the fiscal year 1946-47. The purpose of this program is to aid in the dissemination of information, both fundamental and applied, concerning chain reacting piles and their uses for both science and engineering. The facilities of the Laboratories will be made available to about 35 highly trained scientists and engineers from academic and industrial laboratories who have not had previous experience with piles. Those selected will have an opportunity to attend a coordinated lecture program on the theory and operation of piles and to participate in the research and development program of the Laboratories. This program includes the following two broad fields:

A. Fundamental Research in the Fields of Nuclear Physics and Chemistry. This research will involve both theoretical and experimental work.

B. Design of Piles. This program has as its principal objective the extension of the technology of pile development into the important fields of peacetime application.

The key administrative staff of the Clinton Laboratories is as follows:

Research Director: Professor E. P. Wigner. (On leave from Princeton University.)

Director of Physics Division: Dr. Nordheim.

Director of Chemistry Division: Dr Coe.

Director of Technical Division: Dr. Leverett.

Director of Power Pile Division: Dr McCullough.

Director of Training Program: Dr. erick Seitz.

(On part-time leave from the Ca Institute of Technology.)

The Research Divisions of the oratories have full-time staffs e in the activities of the Laboratories. staffs include scientists and enginee have been involved in nucleonics number of years. The participants training program are expected to in close cooperation with the fu staff in order that the Laboratorie function as a well-coordinated un signments will be made primarily basis of the interests of the partic however, the interests of the Labor must also be kept in view.

The training program will begi 1, 1946, and extend for the entire year. The formal lectures will not until about September 1, 1946.

The lectures will be given by a group of physicists, chemists, and neers. The major portion of these chosen from the Laboratories' sta a substantial fraction will be scientists and engineers who hav extensive experience in the field of science and engineering. The topics lectures will be chosen from the ing fields:

A. Fundamental Nuclear Physics
B. Pile Science (Theory and Oper
C. Radiochemistry.
D. Engineering Design of Piles.

The Clinton Laboratories will living accommodations in Oak Rid the participants. These accommo consist of individual houses, apart or dormitory rooms, depending up dividual needs, in the town of Oak which is a fully equipped modern munity. Transportation is availabl Oak Ridge to the Clinton Labora Requests for housing will be hand Dr. Prescott Sandidge (Address: Bo Knoxville, Tennessee). Moving ex can be arranged.

All participants will be transfer the payroll of the Clinton Labora Questions concerning salaries will ferred to Dr. Prescott Sandidge. I eral a no-gain, no-loss policy w adopted.

Applications for participation sho made to Dr. Frederick Seitz, Depa of Physics, Carnegie Institute of nology, Pittsburgh 13, Pennsylvar

...ompromise Suggestion by the British Association of Scientific Workers

"Scientific Worker," the organ of ...itish Association of Scientific Work... its issue of August, 1946, discusses ...asons wh the "Baruch plan has not ...ccepted by USSR." The commen... sees three such reasons: (1) The ...tion for the abolition of the "veto," ... the USSR considers its only pro... against the UN being used by ...nd Great Britain to enforce their ... the Soviet Union; (2) the supra...l nature of the proposed Atomic ...pment Authority, which would give ...ganization a marked economic (and, ...political) influence and may be used ...ermine the socialist planned econ... the USSR; and (3) the method of ...ding in stages, which (as the com...or sees it) "would mean that the ... monopoly possessed by the USA ...nb manufacture would be streng... in all the early stages by tying the ... of other nations and preventing ...exploiting their own natural re... of the raw materials."*

"Scientific Worker" then asserts ...doubts whether the USSR would ...to any scheme of international in...n in any circumstances appears to ...ounded" and proceeds to outline a ...al which it thinks "it should be the ...f Great Britain to present" "to ... a compromise between the two ... of view. Such a compromise should ...ed on the following points, which ...well be discussed as a basic policy ... A.Sc.W. on the international con... atomic energy.

An effective international Control ...rity should be instituted with pro... for effective safeguards by way of ...ion to protect complying states ... the hazards of violation and eva...

The control should be vested in the ... of an Atomic Development Author... ...he complying nations should cove...o allow officers of the Authority ... for inspection purposes to all mines ...her sources of necessary raw ma... ...and all plants producing fissionable material and to provide the said officers with facilities for satisfying themselves about the amount of fissionable material being produced and that none is being set aside for military purposes.

The Atomic Development Authority would also sponsor research and development in all matters concerned with atomic energy, and should put the knowledge available at the disposal of all the complying nations for the peaceful development of atomic energy.

The plants in which the atomic energy or fissionable material is produced should be operated by the nation in whose territory they are situated and the atomic energy, fissionable material and all by-products should be the property of the said nation.

The officers of the Authority should be subject to the laws of the nation concerned, provided these laws are not in contradiction to the obligations entered into of all nations in connection with this atomic energy control scheme.

(3) The Atomic Development Authority should be subject to the direction of the Security Council which would be the body responsible for dealing with violations and evasions.

(4) The ordinary rules of procedure of the Security Council, including the unanimity rule, should apply to questions of violations of the control agreement.

(5) The complying nations should enter into a solemn covenant never to use atomic energy for warlike purposes.

All existing stocks of atomic bombs should be dismantled and the fissionable material contained in them put to peaceful Industrial use.

No further atomic bombs should be produced.

(6) The international control to be implemented by stages. The various stages to be accompanied by a progressive easing of the secrecy provisions, starting with the release of all fundamental scientific data in the first stage.

The subordination of the ADA to the Security Council, the retention of the existing voting procedure, the immediate outlawing of the atomic bomb and destruction of existing stocks, are the by now familiar suggestions for the conciliation of the American and Soviet points of view. It is noteworthy that as an additional suggestion, the "Scientific Worker" proposes the return from the Lilienthal-Acheson plan of international ownership (or management) of "dangerous" atomic energy installations, to the earlier plans of national ownership and international inspection-proposals which many felt would be particularly difficult for the Soviet Government to accept, because of the large amount of "snooping" by inspection agents they would imply.

...a criticism of this and similar interpretations ...merican plan, see editorial of this issue.

Editorial—

(Continued from page 1)

tious plan of international cooperation envisaged by the Lilienthal board. Other countries, too, may need time for the evolution of their thinking.

* * *

The signing of the Report of the Scientific and Technical Subcommittee (reprinted in this issue) may perhaps be the first step in such an evolution. The contents of this report may appear trivial to Americans, but its unanimous adoption is nevertheless not unimportant. It signifies the consent of the Soviet delegation to base its future attitude on the same set of scientific and technological facts which have dictated the development of our own thinking in the last year. One point in particular, has now become common ground—the close relation between the development of atomic energy for peaceful purposes, and the fabrication of atomic weapons. We recall that outlawing of bombs without interference with the national fabrication of atomic "fuels" for industrial purposes has been one of the main features of the "Gromyko plan."

E.R.

Security Through the Sacrifice of Sovereignty

. . . . Chester I. Barn

The following is from a speech delivered by Mr. Barnard at Controlled Institute of America on September 16. After outlining the known facts about the Atomic Bomb and the proposals made for the International control of Atomic Energy. Mr. Barnard proceeded as follows:

There are those who seem to believe that we should be able to attain the international control of atomic energy without paying for it and who think that particularly the United States and perhaps Great Britain and Canada, who were our partners in the development of the atomic bomb, should be able to do so without giving up anything except the right to use the atomic bomb. There are others who think we should relinquish nothing of the preferred position we have in the immediate present except under conditions that would absolutely guarantee that no other nation should be able to develop atomic bombs in sufficient numbers to be dangerous. These attitudes seem to me to be quite unrealistic and dangerous. I see no possibility of establishing any means that would give such absolute guarantees, nor do I see the possibility of achieving any plan which does not require us to give up something more than the bomb itself. We dare not relinquish our present position except under conditions which insure the possibility of adequate inspection and control and we cannot ask that of other nations without ourselves also submitting to the same conditions. This means that we and all other nations would have to part with a small part of that thing called national sovereignty to the extent necessary to control the bomb in the interests of all. Those who object to doing this seem to me to make as their objective that we shall win the wars in which we may become engaged and nothing more. Let us assume that we shall always win our wars. It will still remain, I think, that the winner in modern war will also lose. The destruction which the wars of the future will impose on winner and loser alike is likely to make the question of who wins of little consequence. More than all, I think those who take this independent and isolationist position do not sufficiently envisage the peacetime consequences of failure to establish international control of atomic energy.

Let me close, then, with a broad picture of what I think those consequences are. If, unhappily, we should definitely discover that it is impossible to secure a workable international agreement for the control of atomic energy, we shall begin with increasing energy to speculate on whether or how soon other nations will have the secret and will be engaged in the production of atomic explosives. It will not be long before we shall first fear and then be certain that other nations have this means of destruction. By that time we shall be certain that though there is no defense against the atomic bomb, it is at least possible for us to reduce our vulnerability. The concentration of our population and our industries in large cities and in vast manufacturing plants is the condition of maximum vulnerability not only to atomic bombs but to other types of bombs as well. The reduction of that dangerous condition calls for the dispersion of both our industrial plants and our population. If that were to be done quickly—say in 10 or 20 years—the cost would be so great as to reduce our standard of living to an extremely low level and even the beginning of an attempt to do so would so affect the structure of urban real estate values as well as those of industrial plants as to shatter the entire economy of the country. The drastic destruction of the values of both residential and other properties and the extreme opposition to the forced dispersion of populations all seem to me impossible of accomplishment except under a scheme of regimentation that would be nothing less than totalitarian government. Before such a redistribution of our industrial resources could be accomplished and even after that, we should be subjected to a life of perennial fear; and the burdens of constant preparations for defense on a scale of which we have no experience in this country in peace times would be our perpetual lot.

The perennial fear of impending destruction to which I have referred is probably more deadly to our civilization than even the immense burden of taxation which constant preparation for defense against atomic warfare would impose. The British having a more concentrated urban civilization than we, and having already experienced the immense damage of aerial bombing, are more realistic about this aspect of atomic armament than we are likely to be. Lest you think I am scare-mongering merely to vent my personal opinions, I should like to quote from a recent report on "The Er Atomic Power" by a Commission pointed by the British Council Churches, as follows:

"It is not easy to contemplate nature of our lives if the political tempts to find methods of internati control prove fruitless, and thus a of tension were to arise comparabl that which existed in the years be the war which has just ended. But can turn our minds back to the y between 1935 and 1939 and con what they would have been like if atomic bomb had already been inve Even then, with a far less probable pect of less complete destruction disorganization, it was clear that E pean civilization could not long en the uncertainty created by the con danger of war. The mere discover the atomic bomb itself, even if it is n used, might well create such strain our society as to destroy it. If hu experience counts for anything we only conclude that in such a stat insecurity most men and women w be forced back into a life that acce impermanence as something inevit and would live only for the present more powerful solvent of any society be imagined than the general accept of this view. It would be blindnes ignore the presence already in the m of many young men and women feeling in some ways akin to such des a belief that for them political acti futile, for they are helpless in the of forces quite beyond their control

When I first heard the news of bombing of Hiroshima, I said: " goes the freedom of the American ple." I have since been more optim having seen the possibility of a rea plan of the international control of means of destruction. Whether that can be realized depends not only ourselves but upon the peoples or governments of other nations. If will not accept such a plan, we are less; but if they will, it still remains us also to accept the plan and to pay part of the price that all must pa make it work. Though there are dan that no plan would work indefinitel seems to me certain that the conseque of failure to secure the adoption of a plan are the destruction of the and means of American democratic

The Facts

Soviet proposal, as presented to mmission by Ambassador Gromyko e 19, calls for a mere agreement hibit the production and use of weapons and to destroy any stocks nic weapons within three months atification. The agreement would a declaration "that any violation serious international crime against ty." It would also require the sig- nations to enact national legisla- oviding severe penalties for vio-

Soviet proposal as thus far pre- does not go further than the U. S. Nor does the Soviet proposal in ke violation of the proposed treaty onal and international crime for ndividuals can be punished."

U. S. Delegation has hoped that xploration of the Soviet plan it be found to contemplate creation hinery for holding violators (par- y officials of a wrongdoing govern- r, if possible, such a government accountable before an internation- nal and for punishing them.

ated efforts to elicit from the So- presentative reassurances on this ave thus far proved fruitless. So we have been able to determine e statements of the Soviet repre- ve, the Soviet proposal to declare n "a serious international crime" accompanied by any machinery for ment other than an appeal to the y Council, with the veto intact to s a possible shield to the violator. roposal for national legislation prevent misuse of atomic energy vate individuals within a country, would of course have no effect on ational governments themselves. er, the Soviet proposal contains no tions for international preventive measures as contrasted with pun- t after an offense. Obviously, pre- is the essence of control.

FUSAL BY UNITED STATES TO DIFY THE PRINCIPLES OF ITS AN

etary Wallace states at several that he believes the Russians would te a workable agreement if the States were willing to modify its o as to make it more acceptable. e says:

may feel very self-righteous if efuse to budge on our plan and Russians refuse to accept it, but means only one thing—the atom- mament race is on in deadly ear- "

gain:

must be prepared to reach an ement which will commit us to osing information and destroying our bombs at a specified time or in terms of specified actions by other countries, rather than at our unfettered discretion. If we are willing to negotiate on this basis, I believe the Russians will also negotiate seriously with a view to reaching an agreement."

And finally:

"The Russian counter-proposal itself is an indication that they may be willing to negotiate seriously if we are."

The United States delegation cannot consider modifications in those fundamental principles of its plan which, in our judgment, must be maintained to meet the mandate given the Commission by the United Nations General Assembly last January. We have repeatedly encouraged the presentation of any other proposals which would meet this mandate. In particular, we have indicated that we would welcome any suggestions to strengthen the proposed controls. And we have always displayed readiness to negotiate details in collaboration with all the other delegates as long as the details fit within the proper framework of principle. We have insisted only that the Commission abide by its instructions, which require it to "make specific proposals . . .

"(b) for control of atomic energy to the extent necessary to ensure its use only for peaceful purposes;—

"(d) for effective safeguards by way of inspection and other means to protect complying States against the hazards of violations and evasions."

These instructions were subscribed to by the Soviet Union, the United Kingdom, and ourselves at the Moscow Conference of Foreign Ministers last December and were unanimously endorsed by the General Assembly of the United Nations on January 24, 1946. Any modification which achieved agreement, but failed to provide effective control and safeguards to prevent the misuse of atomic energy and to give timely warning of violations, would merely create a false sense of security. Such an agreement would be directly contrary to the specific and unanimous instructions of the United Nations. It would be a fraud on the peoples of the world.

(Signed) Bernard M. Baruch

Documents released by Mr. Baruch reveal that Mr. Wallace and Mr. Baruch met on September 27 to discuss the Wallace letter. At this meeting, Mr. Wallace, when confronted with the details contained in the Baruch memorandum, admitted that he "had not been fully posted on the facts."

It appears that Mr. Wallace first agreed to a statement (satisfactory to Mr. Baruch) in which he (a) stated that he was impressed by the reasonableness and sincerity exhibited by the United States atomic energy delegates in their negotiations, (b) admitted that his information concerning Baruch's proposals had been in error, and (c) emphasized his agreement with Baruch on the importance of the following points: (1) Any plan of atomic energy control, although it must involve a series of steps or stages in achievement, must be agreed to in advance by all parties. (2) The specific sequence and substance of the stages to be incorporated in the treaty shall be freely negotiated and specifically and clearly laid down. (3) The machinery of atomic energy control shall contain adequate inspection and other safeguards, and shall contain no loopholes whereby any nation, large or small, could threaten the peace of the world and at the same time prevent concerted action to maintain the peace. (4) Satisfactory agreement on international atomic energy control is dependent on the development of mutual faith and confidence among the nations.

Instead of signing this, Mr. Wallace on September 30 proposed an alternative statement (unacceptable to Mr. Baruch) in which he omitted both his admission of factual error and his express approval of Mr. Baruch's course of negotiations. Mr. Baruch has pointed out that these omissions "were gravely dangerous to the delicate negotiations now under way. They create confusion and division among our people." (We refer our readers to the **New York Times** of October 3.

We quote from the alternative Wallace statement merely because it presents Mr. Wallace's position at the present writing. (The question of Mr. Wallace's error and their consequences is adequately dealt with in the Baruch memorandum.): "There still remains the central issue for which my letter was directed but which received no mention in Mr. Baruch's memorandum. The present impasse of the negotiations for atomic energy arises from two basic points of disagreement. The first and most important one relates to the question of whether the United States should continue its production of stockpiling of atomic bombs during the period of transition before international control. The second relates to the Russian refusal to agree to an international system of inspection to control atomic energy production so as to assure peaceful use. The serious point of disagreement on which to work is that the United States Atomic Energy Commission has been deadlocked for some time and serves to demonstrate the major thesis of my letter to the President—the absence of an attitude of mutual trust and confidence between the United States and Russia."

BULLETIN of the
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1126 E. 59 St.
Chicago 37, Ill.

NOTES ON CONTRIBUTORS

CHESTER I. BARNARD, *President of the New Jersey Bell Telephone Co., was a member of the State Department Board of Consultants which wrote the "Acheson-Lilienthal" Report.*

GREGORY BATESON, *the Anglo-American anthropologist, is now on a Guggenheim Fellowship.*

LEW KOWARSKI, *one of the French pioneers in fission research, was a leader on the English and Canadian atomic bomb projects. He is now Scientific Director of the French Atomic Energy Authority.*

DAVID E. LILIENTHAL, *Director of the Tennessee Valley Authority, was Chairman of the State Department Board of Consultants on Atomic energy.*

GEORGE W. MERCK, *President of Merck Co., the chemical firm, was in charge of the U.S. wartime research on biological warfare. The article in this issue represents the principal official release on this subject to date.*

C.P. RHOADS *is Director of the Sloan-Kettering Institute for Cancer Research, Director of the Memorial Hospital and Chairman of the Committee on Growth, National Research Council. The article in this issue is from a talk given before the Scientific and Technical Committee of the UN Atomic Energy Commission and was issued by the Baruch office.*

BERTRAND RUSSELL *is one of the great living philosophers.*

PUBLICATIONS OF THE BARUCH OFFICE

The office of the American delegation to the UN A… Energy Commission has issued so far four volumes of pu… tions entitled "Scientific Information Transmitted to the U… Nations Atomic Energy Commission by the United States … resentative."

Volume 1, issued on June 14, contains a preface by … Tolman and seven articles on Atomic Energy (Bacher and … man), Production of U235 and Pu (Nichols and Ruhoff), … tary Effectiveness of the Atomic Bomb (Solomon and Morr… on the Radioisotopes in Research (W. Cohn), Therapeutic … (Rhoads and Solomon), Medical Applications (Stone and … ilton), and Biological Warfare (Merck, Fred, Baldwin, … Sarles).

Volume 2, issued on July 10, contains a preface by … Oppenheimer, and articles on Future of Atomic E… (Compton and Jeffries), High Energy Physics (Lawr… Radiation Chemistry (Franck and Burton), and the Ga… Diffusion Process (Urey and Williams).

Volume 3 (August 15) contains a bibliography of a… on atomic energy and nuclear physics published in US … August, 1945.

Volume 4 (September 5) contains a short article on n… power, by a group of scientists from the Clinton Labora… at Oak Ridge.

The present issue constitutes a double number—Volume 2, Nos. 7 and 8. The price of a single cop… of this issue is 20c.

The opinions expressed in the editorials and othe… articles printed in the Bulletin do not necessarily rep… resent the official views of any organization.

Material in this Bulletin is released for publication a… 12 noon. Saturday, October 12.

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EDITORS:

H. H. Goldsmith E. Rabinowitch

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itorial:

hich Way for American Science? . . .

MIC ENERGY ENTERS CIVILIAN LIFE

hree months after the Atomic Energy Commission was ated into being by the McMahon Bill, the President has nced the names of its members. They are good names— hairman, David E. Lilienthal; the members, Robert F. er, Lewis L. Strauss, William W. Waymack, and Sumner T. are men of good will. They are also outstanding men of and administrative experience. The Chairman, in particu- rings with him the reputation of a proved administrator gigantic public works project, a victor over red tape and cal patronage—exactly the qualifications needed for the task before him. His familiarity with the political and aspects of atomic energy is well known.

he scientist on the Commission—Professor Bacher—is a g authority in the field of atomic energy, and has also ly participated in the work of the UN Commission. All ists acclaim his choice and his decision to devote himself work.

oyal cooperation between the new Commission and any ational authority which may be established by the United ns, is certain. In the eyes of the world, the appointment ienthal and his colleagues must appear as a demonstration e will of America to dedicate atomic energy to peaceful ess of knowledge and well-being of man. In this the new ission can be assured of the whole- ed cooperation of all scientists.

caliber of the men who have accept- e appointments on the Commission the prophecies freely made by the nents of a dictorial Administrator dollar-a-year advisory board. We hat the Commission will achieve the success in the appointment of its ger, Division Directors and other key nel. A "high Army official" was by newspapers as saying that the ission will have to fall back on offic- active duty because no outstanding n will agree to accept employment ernment salaries. Once a congenial phere of common scientific endeavor ablished in the laboratories and of the Commission, we have no that the best scientific and technical will be available to it. Outstanding scientists and engineers will be o become members of a group which ars will remain the advance guard most spectacular development of e and technology.

IN THIS ISSUE

SCIENCE, A BRANCH OF THE MILITARY?

Several articles in this issue are devoted to the position which the Armed Forces are rapidly acquiring in the organization of American science, largely because of the failure of the 79th Congress to establish a National Science Foundation. The history of this failure is traced in Prof. Parsons' article.

Apart from the laboratories operated directly by the Armed Forces (which at present still include the colossal layout of the Manhattan District), the Army-sponsored research accounts, in the current year, for an expenditure of 70 million, that of the Navy, for over 20 million. Compare this with the total of 30 millions available for scientific research at the Universities in 1940, and we understand why "Business Week" says: "the odds are getting better all the time that pure scientific research will become permanently a branch of military establishment."

The articles by Profs. Morrison and Stern in this issue are eloquent pleas for a reversal of this trend. A few months ago, commenting on the passage of the McMahon bill for civilian control of atomic energy, we said that a growing belief that the United States is engaged in a gigantic arms race, would lead to a rising tide of military domination over all activities of potential use in war.

We realize that the Army or Navy is proceeding in a reasonable fashion in granting liberal contracts for fundamental research.

But having granted this, we must emphasize that organizational subordination of science to the Armed Forces is an evil thing. What would the American people say if the schools of the nation were taken over by the military—because civilian authorities failed to provide them? Even if the Army were to double the number of teachers and to provide them, at long last, with adequate salaries, public opinion would still be horrified. It would deem it, and correctly, treason to the basic tenets of education in a free society.

It should be clearly understood by the public that free scientific inquiry is as integral an element of a civilization based on individual freedom, as is free education and free expression of opinion. Without it, this civilization cannot retain its leadership in various spheres of human endeavor—not even in that of military power.

The fight for the liberation of science at large from military sponsorship—first of all, for an adequate National Science Foundation—must be taken up with the same vigor as was the now victorious fight for the civilian control of atomic energy.

E. R.

Atomic Energy and World Peace . . .

. . . . Harold C. U

Alfred Nobel, the anniversary of whose birth we celebrate today, was as we all know the inventor of high explosives, which have proved to be useful in peace and war. He was also a man who throughout his life studied and promoted all possible methods for the avoidance of war. Many scientific men today, of far less eminence than Alfred Nobel, find themselves in a similar position. We have produced explosives of far greater effectiveness and power than any of which he dreamed, and we also do not wish to see these explosives used for war purposes. Also, many of us, when we meet with criticism for our non-scientific activities, turn to the example and the spirit of Alfred Nobel for approval, and hope that history deals as kindly with our endeavors as it has with his. No one today criticises his activities in behalf of the abolition of war, though the "realists" of his time undoubtedly regarded his ideas and activities as visionary and impractical. We respect him today as a scientist and engineer, as a man of broad interests and culture, as a man of vision and courage, and we pay tribute to his fellow-citizens of Sweden and the world who have done so much to maintain the lustre of his name.

Today, on popular occasions of this kind, we usually discuss some aspects of his attempts to bring peace to this planet, partly because of the difficulty of discussing scientific and engineering problems before a popular audience, but more because of the transcending importance of the problems of war and peace which he so early foresaw. Probably never before has this problem of settling the world's disagreements by methods other than war been so universally discussed as it is at the present time, and probably never before has it been discussed more intelligently than it is now. Experience of the past does not encourage optimism, but war has become so effective that we feel impelled to work and speak for the abolition of war, even though we may think that the probabilities of success are small.

This address was delivered before the American-Scandinavian Foundation at the Nobel Birthday Fete on Oct. 21.

A YEAR WITH THE BOMB

A year ago I reviewed the situation in regard to the atomic bomb and the general conclusions to which it forced us. Any such discussion could hardly have been expected to be perfect, but today I see no reason to retire from the positions taken at that time. The technical methods of waging war are now so effective that they are well-nigh intolerable even without the atomic bomb. If these bombs are manufactured and stored by any government of any kind, they will eventually be used, and if used on a sufficiently large scale, they may completely destroy our civilization. It is to be hoped that methods can be devised which will make it possible to stop such manufacture. In some way the present international anarchy of war must be replaced by world law which requires world government in a true sense. I am surprised and gratified at the greatly increased appreciation of the situation created by the atomic bomb and other modern weapons of war, and particularly by the greatly increased acceptance of the necessity of ultimate world government, by many people of this country.

However, even after a year's time in which the problem has been thoroughly discussed, many thoughtful people still believe that atomic bombs may be useful in order to enforce peace. I merely wish to reiterate the statement made a year ago, that atomic bombs are evil and that they cannot be used to maintain peace. To maintain peace by the use of the most powerful weapon of war which has ever been devised is a complete contradiction in terms; so contradictory, in fact, that no effective use of the atomic bomb could possibly be made. In order for a weapon to be effective for the preservation of order, it must be appropriate to that purpose and it must be one which mankind is willing to use for that purpose. It is the completely inappropriate character of this weapon which makes it useless as a police weapon. It will be used only by those who believe that the proper way of settling international difficulties is by the resort to war.

IRRESPONSIBLE TALK OF PREVENTIVE WAR

Today I wish to discuss other a
of this problem. During the last
months public discussion of interna
problems, in this country at least
moved rather dangerously toward
sideration of so-called preventive
One sees this tendency perhaps
markedly in the trend of news in
ican newspapers, but our fears in
to such a war are also not partic
quieted when the high-ranking offici
large countries feel that they must
statements denying the imminence o
in the immediate future. This adv
of a preventive war is not made o
but largely by inference. It first ca
my attention when a commenceme
dress made at Swarthmore Colleg
June* was reported in the American
in August as advocating an imm
attack upon other countries. Some
ments in that address were not qu
as much as they should have been,
is nevertheless true that an address
ered before an audience of a colle
the Society of Friends without obj
on their part, and in fact, with i
tions of approval, was reported b
American press in quite a different
Since that time I have noticed, an
haps you have, a tendency for the
lines of news to suggest the necessit
desirability of solving our difficult
national situations by violent
Those who consider war as a mea
settling our problems should full
preciate the great danger in such
dertaking, to us in this country a
as to the peoples of the whole ci
world.

First, of all, this point of view
one widely held by the people
United States. Frightening news m
sult in an increase in the numb
newspapers purchased and read,
does not necessarily indicate a des
the part of the people of the
States to engage in any aggressiv

* This address, by H. C. Urey, appeared in
fairs v. 1 no. 1, August, 1946.

n this country read our newspapers listen to our radio with a healthy icism, and reserve to ourselves the to make our own decisions. Also, a world war, it is almost inevitable extensive military preparations will nue after the close of the war, y because of the momentum ac- d during the war, and such activities t necessarily mean general approval e part of the sovereign people of this ry. The United States has changed sition in the world with respect to fense in a marked way, largely be- of the effect of the airplane and of the atomic bomb. This country solated to a very large degree until entury, but today that isolation has physically destroyed. This changes inking of many people of this coun- nd leads many individuals to think utions for this problem of insecurity appear to be quick and definite, but may be anything but that, and in may prove to be very painful and active, to us as well as to others. ver, I have the greatest faith in the good sense of my fellow-country- in spite of the disturbing fluctua- in its exercise over short periods ne.

VENTIVE WAR—AN SORY SOLUTION

let us consider in more detail the y of preventive wars as a solution r present difficult international sit- . There is a tendency on the part ne to discuss such matters in hypo- al ways, but this is not usually done. , let us ask the question as to what most likely source of war in the at the present time. It is useless to e that important wars will arise small countries, and because of the of the airplane and the atomic it is probable that all the countries rope will realize that they are small. leaves only the U.S.S.R. and the d States as the possible contestants war that we foresee in the immedi- uture, and this is tacitly assumed references to war in the near future. thoughtful people both here and d believe rightly or wrongly that ountry may attack while only we the atomic bomb, and further as- that such an attack could be easily made and quickly won by this weapon alone. Not more than a small minority of our people believe this, but those suggestions are so dangerous, to my mind, that it is worthwhile clearly and publicly to discuss the consequences of such action.

PROBABLE COURSE OF SUCH A WAR

In order to attack, we must think of bases from which the attack would be made. We might think of those bases in the United States, but if so, war planes must cross the territory of other countries in order to attack. Perhaps someone thinks that Northern Canada would be an appropriate base, but Canada is not part of the United States, and hence military collusion with that country would be required. Others perhaps think of England as such a base, but again England is not part of the United States, and certainly she could not view with favor the use of that island as a base of attack. It would be highly unpleasant to the English people, and the cooperation of England might not be secured, and I think probably would not be secured. We might think of the Middle East, but we should note that it is halfway around the world from us. We might consider Japan, which we now occupy, or some bases in that neighborhood, but it is easy to see that no vital points of Russia are immediately accessible from those positions. It is not easy to see how anyone seriously considering this problem would propose to start and maintain such a war.

We must also consider what the possible consequences of such an attack would be. All Europe would be almost immediately occupied by our enemy. And this would entail eventually another landing in Europe and a longer and slower and more laborious battle across that continent, with the complete destruction of the cradle of European civilization the inevitable result.

Perhaps some have harbored the idea that conquests can be made and maintained in the future by the use of the atomic bomb alone. An enormous amount of damage undoubtedly could be inflicted, and if systematically repeated at intervals, the industrial potential of other countries could perhaps be kept so low that the manufacture of major weapons of war of any kind would be impossible. Such a course of action is fantastic, and will be regarded as such by the people of any country or any race. In order for a preventive war to avoid such a course, it would be necessary to follow the initial bombardment with an attack using other means, and by the eventual occupation of the enemy country. This in turn would require another landing on beaches somewhere, and a long and bloody trek across continents again. Such prospects can only cause the greatest fear on the part of people who live in countries which may lie in the path of such battles.

The almost insurmountable problems of occupation which would follow such a war are apparent. It is only necessary to note our occupations of Germany and Japan to realize that occupations after such a preventive war would be far more arduous than those we have now. This problem of occupation would be far more difficult than that which we face in these countries at the present time, and without such occupation this line of action presents no solution to the world's problems at the present time.

THE SOCIAL IMPLICATION OF PREVENTIVE WAR

Many people of the United States understand this situation and see clearly the impossibility of a small preventive war. They know that wars in the future will be world wide, and that they will bring the whole aftermath of difficulties that we have observed after World War I and World War II. Moreover, a great fraction of the people of the United States, as well as those of other countries, regard this whole question of aggressive war as thoroughly immoral. It violates their innate sense of decency. Before this country can be brought to a point where an aggressive war can seriously be undertaken, it will be necessary to change the thinking habits of the overwhelming fraction of the population of the United States. In order to change these opinions of the people of the United States, an extensive re-education program would be vitally necessary. Germany undertook such a program in the 1930's, but in spite of all such propaganda on the part of the German Government in the years before the war, it felt that it was neces-

sary to introduce concentration camps in order to silence a German minority. It is to be expected that if any aggressive war is undertaken by the United States, similar procedures will be required, for there would be a very determined minority at least who would choose concentration camps and death rather than sanction either actively or passively the total immorality of a preventive aggressive war. The Christian and Jewish religions have too strong a hold on the morals and ideals of our people to permit them to do otherwise. Briefly, the democratic institutions of the United States must be effectively destroyed before such an aggressive war is possible.

In the minds of many people who may consider the possible advantages of preventive war of the type that I have mentioned, there lurks a great fear of Communism. I myself thoroughly believe that our political institutions and economic institutions of the Western world are far superior to those practiced in other parts of the world. In fact, I sympathize with those who do not wish to see our democratic institutions and our free economic system destroyed, and with a substantial fraction of the world disagreeing with our views in this respect, the danger to such institutions is not at all negligible.

On the other hand, let us trace briefly the course of free institutions after World Wars I and II. I can so well remember how representative government seemed to be steadily increasing its hold over the masses of the peoples of the world before World War I. There was a stable government in Germany before that first war, and there was in it the definite element of government by law rather than by men. There has been no stable government in Germany since that war. Freedom and democracy as understood by us never did exist in the eastern part of Europe, and does not exist there now. Italy became a dictatorship, as did Spain, and a dictatorial military clique secured complete control of Japan in the years between the wars. After World War II it is perhaps too early to judge trends correctly, but I cannot see that democratic institutions have any reason to feel more confident now than they did before the war, and I do not believe that free economic systems have reason for more confidence than they had before. The effects of wars on the economic side is again to destroy freedom. In all its attributes freedom is a delicate plant, which thrives only in the soil and air of peace and security. A modern war necessarily disturbs the economic foundations of our society, for it increases the control of government over all phases of the economy as well as other institutions of a free country. It is to be expected that after any future war the problem of restoring freedom in all its aspects to a country such as this will be far greater than it is at the present time.

THE POSITIVE SOLUTION—WORLD GOVERNMENT

The solution of the problems which face us today and which were such a great concern of the man whom we honor today, cannot be made on the basis of statements and arguments in regard to things which should **not** be done, and these remarks are distinctly on the negative side. Moreover, such a vast problem must be solved by comprehensive methods, though such methods must necessarily consist of a succession of many detailed steps. A great human problem can be solved only by great and glorious ideas that cause men to lose their individual selfish and narrow desires in a great emotional and intellectual crusade. The existence of the United Nations indicates the great desire of people for a solution in this century. That fundamental desire will grow in the years to come as people everywhere realize the enormous destructive powers of the airplane and other flying vehicles, and of the instruments of war which they carry. It will also grow the more we use rapid means of transport and communication in the years to come. People will realize the essential unity of our species regardless of the variations in colors of skin, sounds we use in speech, and religious tenets.

But wishes and desires will be frustrated without proper mechanisms for their realization. More and more people realize what these instruments are, and also the price which must be paid for them. Also, leaders are appearing who are fearlessly stating what these are. Mr. Wendell Willkie left a monument more enduring than granite in the words "One World," and he meant a **free** world. Others such as Mr. Harold Stassen rageously pronounce the words "W Government" and "sovereignty," point their meanings. World Governm in my opinion is the proper intrument to solve this age-long problem of re ring wars. It is also the idea to rally hearts and minds of men. It is eas state this conclusion, but the road al is difficult and dangerous, and it is possible to map in detail the exact co to follow, but if we do not clearly fearlessly realize and fearlessly state ultimate objective, it is not possibl guide our steps toward that end.

Today war, in spite of the United tions as it is at present constituted, is ultimate method of deciding controve between nations and groups of nati It cannot be eliminated as the ulti method of decision unless some o method is introduced for this purp and this method must be the only met available for this purpose, for two more ultimate methods cannot exist the same time. The only substitute for anarchy of war that has ever been dis ered and proved over limited areas of world for any great period is the es lishment of a system of legal methods settling disagreements. It is not poss to establish laws without a governm to make laws and enforce them. W law without a world government ca exist. International law as discusse the present time has the same basis force as the ten commandments. S moral laws are very important, but cannot be codified or enforced by co and hence offer no security to the abiding against the criminal minority

Finally, "wars to end wars" may b high-sounding statement, but the exp ence of the past shows that it is only t Peace is not the absence of war, but existence of justice and order. Wars make the establishment of peace m remote and more difficult of attainm

These statements I make with con tion, though I make no claim to inf bility with regard to them. I only h that they will be considered seriousl hope that such ideas may rally the gr the good, and the fearless to a cause to Alfred Nobel, who in his lifetime in the years since he lived has done much toward the solution of this imp tant problem.

he Laboratory Demobilizes . . .

. . . . Philip Morrison

little more than a year ago we first Professor Tsuzuki, the Tokyo radi-st. He came to the bustling tempora-adquarters of General MacArthur in first confused week of the occupation l us about Hiroshima. He is a small, man of great dignity and used to de-ce. He showed us his reports of the tion casualties in Hiroshima, and an air of detached, scientific enthusi-he gave us reprints describing his as a young man in Philadelphia. hat time he had induced radiation s in rats by acute doses of X-ray. ymptoms he had noted so carefully in ats who died twenty years ago were y parallel to those familiar by now e patients who crowded the tempo-hospitals of Hiroshima. In real con-Professor Tsuzuki grasped my arm said: "I did the experiments years but only on a few rats. But you icans—you are wonderful. You have the human experiment!"

one could fail to carry the scar of a cutting thrust. We knew that ican science and industry did not the guilt for those tragic deaths; l not need to apologize. Our science ngaged in a total war, a war for sur-more than that, a war for the e of culture itself. In that war we withhold no decisive weapon. But ki first made clear to me how heavy the responsibility on science, and all science in America, to help y in the years of victory the waste-rror of war.

hould like then tonight to talk about hat confidential questions. They ainly matters of professional con-they worry physicists like me. But last year we physicists have seen ur private concern is related to the n of all, and other speakers tonight made very plain that there is a real rave tie between scientists and every About a year has passed since the nded; and in that year science has arned how to demobilize. It is my that this is not only a shameful dangerous and a foolish state of and I should like to tell you how it about.

MOBILIZATION OF SCIENCE NG THE WAR

all know what happened to science I speak mainly out of my own ex-ce of American science—in the war. mobilized with fierce single-mindedness for war. Not even a good seed crop was left in the schools. The tree of scientific knowledge was shaken hard for its fruits. Off they dropped; radar and its related techniques—proximity-fuse, guided missile, television, the atomic bomb, and many less spectacular but very useful things, for example, the application of statistical analysis to air operations.

The Office of Scientific Research and Development, an independent agency under Dr. Vannevar Bush, spent several times more for research each year than had ever been spent before. That money was spent in two ways: Hundreds of laboratories in industry and universities the nation over were given jobs to do on a contract basis; and several very large and tightly-organized laboratories were set up and operated to do key work, like the famous Radiation Laboratory in M.I.T. where radar was largely developed. The laboratories of the Manhattan District were of the latter kind. Results were spectacularly good. The services and the entire informed public came to view scientific research as a central activity of war. It was perhaps not widely realized that wartime research had lost much of its character as research and had become programmatic research or development. Roughly the two activities are distinguished by their objectives: Research attempts to increase knowledge, which brings with it the power to control phenomena, but does not set itself defined goals; while development, which in wartime used research personnel and many research methods, has a defined objective. A true research laboratory should find it hard to say what it could mean by finishing its job; a development laboratory knows when the bomb or the radar set or the anti-malarial drug is working according to specifications. War experience showed that the extraordinary pressures of war could bring great accomplishment from the large laboratory, and that from a heavily supported effort worthwhile results almost inevitably flowed. This was a well-learned lesson; I am afraid it is too well learned.

Nuclear physics is not an average field of science; its connection with bombs and turbines and rockets is a little too close. But I believe it is a typical one; within this field are now exhibited in full clarity what many fields of science feel as more or less inexplicit trends. Nuclear physics today—and I speak only of academic research in that field—is very like big business. There was a conference last month of nuclear physicists at Princeton. Most of the talk was on the abstract problems of the fundamental particles. But the people who came were not in the least abstracted. The same college at Princeton houses annually labor-management conferences of similar size, and one of the men in charge of arrangements told me that the physicists had about three times as many wire and phone messages as the business men and union leaders who attend the industrial relations meetings! The nuclear physicists are, as you well know, busy in the UN. The Army is sending some of its officers to Princeton to enter the field. The Manhattan District is now operating four laboratories—Brookhaven, Argonne, Berkeley, and Oak Ridge—of which the smallest proposes to do more work than the largest laboratory in the country did before the war. At least half a dozen universities have plans which only California would have contemplated in '39.

MILITARY FUNDS NOW CHIEF SUPPORT FOR U.S. SCIENCE

The money, and it is real money, well in the tens of millions a year, is coming today from two main sources. The Army, through the Manhattan District, working chiefly through the large laboratories just mentioned, is a major supporter. In principle, however, this support will come from a special agency, the Atomic Energy Commission, when that body shall begin to function. The other large source of funds is the Navy, through a new bureau called the Office of Naval Research. To indicate how much nuclear science owes to the services, a few examples will be useful. At the last Berkeley meeting of the American Physical Society, just half the delivered papers—mind you, perfectly open, published papers on problems of essentially academic interest—were "supported in whole or in part" by one of the services. Again at Berkeley, there exists one of the best-supported and strongest physics departments in America. But for every dollar the University of California spends in physics at Berkeley, the Army spends seven. The Navy may be said almost without hyperbole to own all of nuclear physics which is not owned by the Manhattan District. About thirty colleges have Navy contracts in the field of nuclear physics alone. Some schools derive ninety percent of their research support from Navy funds. My own department is one of those with relatively little service money; we get about a quarter of all our money from the Navy.

ss at the Atomic Energy Session of the New erald-Tribune Forum on Oct. 29. Reprinted ission of the N.Y. Herald-Tribune.

What is this money spent on? There are, to be sure, some extraordinary developments going on in this country, of a somewhat bellicose kind. Most of the universities, however, are engaged in work not even indirectly supporting the development of weapons. They are doing plain —or perhaps it would be more honest to say rather fancy—academic research. There is, of course, a fashion, which prescribes that everybody who can talk the Office of Naval Research out of enough money builds a big machine to make very high energy particles. But all the work is at least peaceably intended.

The Navy contracts are catholic. They are written for all sorts of work. The ONR has put out a little wall chart which contains useful numbers of all kinds for ready reference, which is somehow symptomatic of the whole confusion. The chart has a mixture of numbers: some of the kind most conventional for physicists, like the velocity of light, and the charge on the electron stand side by side with numbers whose interest derives almost wholly from the atomic bomb and with those of a highly speculative but fashionable kind, like the "weight" of the still poorly known mesotron. To see these data on your wall over the Navy's signature is to fancy yourself part of a rather poor musical comedy.

FORESEEABLE DANGERS IN MILITARY SUPPORT OF SCIENCE

Some of the apprehension that workers in science feel about this war-borne inflation comes from their fear of its collapse. They fear these things: the backers —Army and Navy—will go along for a while. Results, in the shape of new and fearful weapons, will not justify the expenses, and their own funds will begin to dwindle. Then now-amicable contracts will tighten up and the fine print will start to contain talk about results and specific weapon problems. And science itself will have been bought by war, on the installment plan. The easy money for the fashionable problems will lead to an unbalanced development within science itself. The teaching of students—right now a desparately pressing problem if we are to have any science in the years to come—will suffer because of the urgency of research demands. The practice of patenting scientific results and techniques will be spread from the industrial laboratories where it was built and the government laboratories, where its value is doubtful, to the laboratories everywhere, where its effect will be to destroy the traditional free cooperation of science. The armed forces are always sooner or later concerned with secrecy, and with the restrictions such concerns imply on the travels, publications, and even the characters and background of their research workers. Such restrictions will greatly harm our science. It will become narrow, national, and secret. Above all, and in spite of every protestation, American science will appear to the world as the armorer of a new and more frightful war. We are not far from giving that appearance today.

The physicist knows the situation is a wrong and dangerous one. He is impelled to go along, because he really needs the money. It is not only that the war has taught him how a well supported effort can greatly increase his effectiveness, but also that his field is no longer encompassed by what is possible for small groups of men. There is a real need for large machines—the nuclear chain reactors, and the many cyclo-, synchro-, and beta-trons—to do the work of the future. He needs support beyond the capabilities of the university. If the ONR, or the new Army equivalent, G-6, comes with a nice contract, he would be more than human to refuse. The result is necessarily bad. The ONR contracts are in most cases models of restraint, and assiduously avoid the most common errors of unjustified secrecy or patent restrictions. But either the work is military, and the physicist working for war purposes, or it is not; and the Navy and the Army ought not to support and, in the long run, control it. To be sure the military must do their own research. But they cannot do all research. The best security will always be a strong and healthy nation, in which science has a recognized and independent place. The national support which science must have, it must get from an agency whose purpose it is to aid research, and not from those who have primarily other responsibilities.

THE URGENT NEED FOR A NATIONAL SCIENCE FOUNDATION

The present situation is perhaps temporary. The Atomic Energy Commission has not yet started. The Navy says that it supports what it admits is work of direct Naval concern as an interim c tribution to the national welfare, a g and ingratiating way of getting rid Navy surplus funds. But what will t its place? In the last Congress there in the House a bill to set up an age devoted to the support of scientific r search and to the education of scienti The bill was known as the National ence Foundation Bill. It proposed to up a government administrative b which would allot funds for research for education in science. The success the OSRD in wartime was the chief gument for the measure. In final f it was supported by the one man most fluential and experienced in the probl the wartime head of the OSRD, Dr. V nevar Bush. But the bill died in H Committee, and it did not there get full support either from OSRD or ot circles which might have at the saved it. Meanwhile, with the closing the OSRD Dr. Bush became chairman a new joint Army-Navy Committee the coordination of their research effo But it is the contention of this talk t such efforts can not be a peacetime c tinuation of the OSRD. Only a Nati Science Foundation can hope to bring peacetime fruition the promise scie held out in war. Such a bill will su come out next session. If real public tention is given to its proper draft and genuine support to its principles must pass. I urge of you that atten and that support.

In a series of talks on the world iss of atomic energy mine must have see a minor family problem, hardly weig enough to demand attention. I am c vinced that it is not. In every sphere life we must prepare for peace if we to have it. We have seen a year of ten based on no new great and transcen differences, but on a whole front of l alignments and specific incompatibili Each of us must demobilize in his way if he is to share in the peace. W science have to demobilize the laborato and earnestly to prepare for the pe we won with victory. To do less is accept the scorn of Professor Tsuz and to replace the hope and the un standing that stem from knowledge w the fear and the bitterness of Hiroshim

ational Science Legislation [1]

rt I: An Historical Review . . . . Talcott Parsons

*. Carl C. Taylor of the American Socio-
l Society and Prof. Parsons have graci-
permitted the Bulletin to publish the
art of Prof. Parsons' article prior to its
rance in the American Sociological Re-
We consider it to be an excellent intro-
n to a subject of prime importance to
natural and social scientists. The rest
s article, which deals with the role of
ocial Scienses in a National Science
lation, will be published in a subsequent*

SCIENCE LEGISLATION AND ROLE OF THE SOCIAL SCIENCES

e proposals to establish a National ce Foundation, which are of para- t interest to social scientists as well those in the other scientific disci- s have, after being before Congress ver a year, failed to get action in osing weeks of the last session. This rtune makes it all the more im- ive that, in preparation for the new of the debate, all groups who have mportant stake in the legislation d be fully informed about the issues at they can exert the most intelligent nce on Congress when a new bill is luced as it almost certainly will be e next session.

e obligation of social scientists is nly important because of their own diate interest in the consequences e proposed legislation. For, since the ion of whether or not to include science in the scope of the Founda- nas been one of the most controver- questions, a satisfactory settlement e whole issue cannot be arrived at ut the fullest possible clarification e role of social science. And surely n turn cannot be arrived at without ing to bear the best informed and fully considered opinion of social cists themselves.

brief history of the legislative pro- s in this field will be useful to pre- a discussion of the issues involved he social sciences. On July 5, 1945, Vannevar Bush, Director of the Office ientific Research and Development, shed his report entitled **Science, the ss Frontier.** This report was the me of a study made at the request resident Roosevelt, of the ways in which the benefits of the mobilization of the scientific resources of the nation for the prosecution of the war, which had center in OSRD, could be carried over to peace time.

THE DISTINCTIVE FEATURES OF THE MAGNUSON AND KILGORE BILLS

The principal recommendations of the "Bush Report," as it has generally been called, were soon embodied in a bill which was introduced into the Senate by Senator Warren Magnuson of Washington (S-1285). At about the same time Senator Harvey Kilgore of West Virginia introduced an alternative bill (S-1297). For the most part, the controversies over the legislation have centered on the differences between these two alternative bills. And the rift between their advocates was not successfully healed at the time that the proposals expired with the adjournment of the Session.[2]

The Bush Report and correspondingly the Magnuson Bill, recommended that the Foundation be governed by a Board of nine members, none of whom should be full-time Government employees, but who should be taken from private life, principally, though not exclusively, from among eminent scientists. In contrast the Kilgore Bill provided that the Foundation should be headed by an Administrator, appointed by the President. The Kilgore bill provided that there should be an Advisory Board, but without power, and one which would be considerably larger than that proposed in the Magnuson Bill. This would be composed about half and half of persons drawn from outside the Government and of representatives of the various Government departments and agencies which had an interest in the work of the Foundation. This was the most serious difference between the two bills and the one over which there was the most controversy.

The other two most important differences were over patent policy and the inclusion of the social sciences. The Magnuson Bill involved no innovations in patent policy, following the practice of OSRD, which left it open to private interests to patent results of work which had been in whole or in part supported by Federal funds unless this right was specifically restricted in the terms of the contracts under which it was done. The Kilgore Bill, on the other hand, provided for rather radical innovations in this field, including a blanket prohibition of the patenting of results growing out of Government-supported research. Finally, the Magnuson Bill did not include any specific provision for the social sciences,[3] though they might have become involved indirectly under its terms in so far as they could have been held to contribute to national defense, to health, or to welfare. While the original Kilgore Bill did not include the social sciences, in the revised form introduced in October, 1945, social science research as part of the "basic sciences," was provided for, though not as a separate division of the Foundation.

The next important stage in the story was the message of President Truman to Congress of September 5, 1945. In this message the President, broadly endorsed the policies embodied in the Kilgore Bill. He strongly recommended that Congress enact legislation establishing a Science Foundation, but he recommended that an Administrator and not a Board have the primary responsibility, and specifically that the social sciences be included.

THE HEARINGS AND THE FIRST COMPROMISE MOVES

On introduction, the Kilgore Bill had been referred to the Committee on Military Affairs of the Senate, while the Magnuson Bill was referred to the Commerce Committee. It was, however, arranged to hold joint hearings on the two bills under the auspices of the Subcommittee on War Mobilization of the Committee on Military Affairs, of which Senator Kilgore was Chairman. These hearings began on October 8, 1945, and produced a large volume of testimony by more than one hundred witnesses.[4] These included many eminent scientists, Government officials, and interested laymen. One day, October 29, was specifically given over to the problem of the role of the social sciences as presented by the Social Science Research Council, which, among organized social science groups, took the primary initiative in this matter. The case was presented by Dr. Wesley C. Mitchell, Professor Emeritus of Economics at Columbia University; Dr. John M. Gaus, Professor of Political Science at the University of Wisconsin; Dr. Robert M. Yerkes, Professor Emeritus of Psychobiology at Yale University; Dr. William F. Ogburn, Professor of Sociology at the University of Chicago; Dr. E. G. Nourse, Vice-President of the Brookings Institution, and Monsignor John M. Cooper, Professor of Anthropology at Catholic University. The problem of the role of social science, however, was frequently brought up by other witnesses, and was often included in the questions that members of the Senate Committees asked of witnesses. . . .

ast spring at the direction of the Eexcutive ttee, President Carl C. Taylor, of the Ameri- ciological Society, appointed a committee of ciety, with himself as Chairman, to consider ation of the Society to the Science Legislation ending before Congress. This Committee met w York in June. It was the unanimous of the members that it was desirable that mbership of the Society should be as fully ed as possible about the issues involved in the ion, and that the appropriate vehicle for this article in the **American Sociological Review.** thor, a member of the Committee, was there- quested to undertake the writing of the ar- The Committee cannot, however, be held sible for the opinions expressed in the article, are those for which the author alone bears sibility.

After the hearings a compromise bill was worked out which on December 21 was introduced into the Senate (S-1720) under the sponsorship of Senators Kilgore, Johnson, Pepper, Fulbright and Saltonstall. Senator Magnuson, it will be noted, did not commit himself to this bill, but nevertheless it was a compromise in that the Kilgore group made a serious effort to take account of the views of the groups which had been supporting the Magnuson Bill. Though S-1720 did not abandon the plan of an administrator, it greatly strengthened the position of the Board, reducing it to nine members and empowering them to make recommendations directly to the President and Congress.

THE RIFT BETWEEN THE SCIENTIFIC GROUPS WIDENS

In the meantime the division outside Congress between the two principal groups became marked. A "Committee supporting the Bush Report" was organized with President Isaiah Bowman —himself a professional geographer— of Johns Hopkins University, as Chairman. This group wrote an open letter to President Truman urging him to support the Magnuson Bill.[5] To this the President replied saying in effect that he saw no reason to change the position he had taken in his message to Congress of September 5, which had been supplemented by two statements which were entered on the record of the hearings through the Director of War Mobilization and Reconversion and the Director of the Budget respectively.[6] In reply to the letter of the Committee supporting the Bush Report, there was organized, under the sponsorship of Dr. Harold Urey and Dr. Harlow Shapley as Co-chairmen, a "Committee for a National Science Foundation" which on Dec. 28 issued a statement, signed by over 200 prominent people from both the natural and the social sciences, which emphasized the basis for agreement and, without mentioning the bill as such, tended to throw support behind S-1720.[7]

During January, 1946, through the intervention of Senator Elbert Thomas of Utah, Chairman of the Military Affairs Committee, the various groups were brought together. As a result S-1720 was somewhat revised and agreement was reached on a bill which was introduced on February 21, 1946, as S-1850.[8] In particular this new version was approved by representatives of the Committee supporting the Bush Report, and became the final Senate version which was supported in the Senate by Senator Magnuson as well as the sponsors of S-1720. It was reported out of Committee in April and placed on the Senate calendar, but did not come up for action until July 1, when after brief debate it was passed, but with one major amendment, the deletion of the provision for a division of social science.

THE BREAKDOWN OF THE FINAL COMPROMISE

In the meantime another move was made from quite another quarter. On January 30, 1946, Senator Willis of Indiana, as spokesman for a group of Senators who had not been previously involved in the problems of science legislation, introduced S-1777, a bill to establish a National Science Foundation by setting up a corporation consisting of fifty members appointed by the President from nominees proposed by the National Academy of Sciences. This Foundation was, subject to the approval of Congress, to set up its own constitution and define its own scope. The final clause included an appropriation of $100,000 for the making of an "initial report and recommendation." In other words, all the work of Dr. Bush and his colleagues, and of the many others who had investigated the problem, was to be brushed aside in favor of another investigation. The Willis Bill failed of passage in the Senate by the narrowest of margins. Its introduction was indicative of the strength of forces which were suspicious of the whole idea of a Science Foundation.

Agreement between the most important interested groups on S-1850 seemed, however, to have been reached[9] and subject, of course, to the usual hazards of the legislative process, the outcome of its consideration was awaited with considerable confidence. The agreement did not, however, hold, and its breakdown was expressed by the introduction on May 15 in the House of Representatives of the Mills Bill (HR 6448). This bill was a very slightly revised replica of the old Magnuson Bill (S-1285). Hearings were very hastily arranged, with the witnesses dominated by members and proponents of the Committee supporting the Bush Report, with both Dr. Bowman and Dr. Bush himself expressing their preference for this over S-1850, in spite of their previous agreement that the latter presented a satisfactory solution of the problems presented by earlier versions. Proponents of S-1850 were not notified of the hearings in advance, and it was only through their own representations, notably those of Secretary Henry A. Wallace, that they were given an opportunity to be heard at all. The introduction of HR 6448 proved to be the fatal step which blocked action on the whole topic in the 79th Congress. It broke the united front of the principal interested groups in support of S-1850, both inside and outside Congress, which had been so painfully achieved. After the passage of S-1850 (as amended) by the Senate, a slightly m ified HR 6448 was reported out by Sub-committee on Public Health of Committee on Interstate and For Commerce to the full Committee. F on July 19, the Committee decided it not have the information necessary action and the whole subject was ta thus blocking any further action be a new session of Congress.

II

THE FACTORS UNDERLYING THE CONTROVERSY

What is the explanation of the fa of the Science Legislation just when situation seemed so peculiarly favora How far did the attempt to include s science introduce the controversial i which so split the advocates of the F dation in general, that the whole c was, for the time being, lost? To an the second question first, the controv over social science seems to have a factor in deepening the general s but not to have been a primary one. primary difficulty centered on the org zation of the Foundation and the pr sions for the distribution of funds, second one was the patent issue, social science seems to have occu third place.[10]

The division of opinion and atti behind the controversy over these is was probably primarily one within ranks of the scientific groups concer But it got involved with general issue national politics in such a way as go far toward destroying the sentially non-partisan character of legislation which most of its advocates had hoped could be maintai and sincerely believed was in fact tified.

The division within the scientific gr was most dramatically expressed in letter to President Truman from the C mittee to Support the Bush Report, its list of signers, on the one hand, the statement of the Committee fo National Science Foundation, organ by Professors Urey and Shapley, and list of signers, on the other. Very br ly speaking, this was a division betw an inner group which had played the l ing role in the work of the Office of Sc tific Research and Development du the war and were associated with the stitutions where the bulk of that w had been done and, on the other h a much broader group of scientists over the country.

WAR TIME TECHNOLOGY VS. PEACE-TIME SCIENTIFIC RESEAR

The first group seemed to be above concerned to preserve the control of Foundation in the hands of highly qu fied scientists who had proved their pacities in the field of war research. turn this seemed to many to mean t

bulk of research under the auspices he Foundation would be concentrated he rather small number of university industrial research laboratories which played the most prominent part in work of OSRD, such as the Massasetts Institute of Technology, Har-l, The University of Chicago, Colum- The Bell Telephone Laboratories, and General Electric Company Laborato- The opposing point of view tended e suspicious of too great a monopoly he hands of a "scientific oligarchy" of a privileged group of research in-itions, both academic and industrial.

ithout in any way depreciating the aordinary achievements of OSRD re-ch during the war, the tendency of second group has been to argue that form of organization it took, though emely effective for the purposes of war, should not serve as a precedent peace-time conditions. In the latter ext the base should be considerably der both geographically and in terms he groups and institutions involved. could on the whole be more readily mplished with an organization which more responsive to the President and gress than an almost wholly indepen- Board would be.

can be said with considerable confi-e that initially the group which has d the "Bush Report" has neither been cularly concerned with any issues of nal politics as such, besides concern national defense and the general wel- nor have they held any specific at-e of hostility to the social sciences. ever, the situation has gradually shape in such a way as to involve these connections; the "Bush" posi-has tended to become identified both political conservatism, and with a e to exclude the social sciences.

addition to the natural feeling of a p of persons who have become ac-omed to playing the central role in of their own kind continuing to do his tendency seems to have been iated with a particular relation of ime research to industry. As a whole ession of the witnesses before the te Committees emphasized, wartime rch was inevitably concentrated in pplied and engineering fields, not in of fundamental science. It was a er of devising, in the shortest time, fic means to attain specific ends, fundamental scientific knowledge, ourse, but not primarily concerned adding to it. It was, in short, tech-ical research, and the center of grav-f technological development as such rally has lain in industry. A very inent role was played by university atories in the program of war re-h. But at the same time the close liaison between industry and physical science which had developed in peacetime tended to be accentuated by the conditions of wartime research.

The financial resources available in industry for the support of research are enormous. For this and other reasons it is not surprising to find that a certain group identified with industry has been skeptical of any proposals to bring the Federal Government into the field of scientific research at all, because they felt the resources at the command of industry were quite adequate, and because they were fearful of any possibility of "government control."[11]

Given the very close relationship between industry and scientific research during the war, and given the general suspicion in industrial circles of any extension of the functions of the federal government it is not surprising, first, that opposition to the whole idea of a National Science Foundation should appear. In effect the introduction of the Willis Bill, and the support it received in the Senate, had this significance. Secondly, it is not surprising that the general weight of industrial influence should, short of virtually blocking any action at all, have been thrown in favor of a program which contained the most elaborate safeguards against "political" influence, by vesting control in the hands of a group of men altogether outside the regular structure of government, and by ensuring that there should be no change in traditional policy with respect to patents. It seems to have been in this way that the interests of an inner group of the wartime "statesmen of science" and of prominent elements of politically influential "big business" have come to coincide, with the effect of turning the problem of the Foundation to a considerable extent into a partisan issue.

In the later stages of the consideration of the problems, in particular this aspect of the situation appears to have become formally crystallized by the direct intervention of the National Association of Manufacturers as a lobbying organization in favor of the Mills Bill, the introduction of which was the primary factor in breaking the united front of the scientific groups in favor of S-1850. The situation was also reflected in the character of the Senate vote on the amended bill, in which the opposition was by a considerable majority Republican, though a number opposed the Hart amendment[12] while a solid bloc of Democrats favored it. This drift of the issue can only be felt to be highly unfortunate by all the scientific groups, natural or social, who rightly feel that the fundamental orientation of their fields of knowledge, and its potential significance to the welfare of the nation, are altogether above and beyond the immediate political issues of the day.

[2] Three other bills, the Byrd and Fulbright Bills in the Senate and the May Bill in the House, were much more limited in scope. In order not to complicate the exposition unduly, these bills have been omitted from consideration in the following discussion.

[3] Undoubtedly as a matter of deliberate policy.

[3] **Hearings on Science Legislation** (S-1297 and Related Bills) Parts 1-5. Government Printing Office, 1946.

[5] For the text of the letter and the list of signees see **Science**, Nov. 30, 1945.

[6] **Science**, Jan. 4, 1946. **Science**, since it was taken over officially by the AAAS on Jan. 1, 1946, has carried a full running account of developments in connection with the Science Legislation.

[7] For the text of the statement see **Science**, **Jan.** 4, 1946, and for the list of signers the issue of **Jan.** 11, 1946.

[8] See the summary of events up to this point by Dr. Howard A. Meyerhoff, **Science**, March 1, 1946. S-1850 provided for a Division of Social Sciences. It did, however, qualify the authority of this division by stating (p. 3, 1. 16ff.): "The functions of each division shall be prescribed by the Administrator after receiving the advice of the Board except that until the Administrator and the Board have received general recommendations from the Division of Social Sciences regarding the support of research through that Division, support of social science research shall be limited to studies of the impact of scientific discovery on the general welfare and studies required in connection with other projects supported by the Foundation." Dr. Meyerhoff (**Science**, June 21, 1946) states that this limitation was inserted at the insistence of representatives of the Committee Supporting the Bush Report.

[9] The most important evidence of the generality of this agreement lies in the vote of the Council of the American Association for the Advancement of Science, the most representative single body in the field. This vote, in support of S-1850 was by the overwhelming majority of 233 to 10. On its basis Dr. James B. Conant, President of the AAAS, wrote a letter to all members of the Senate urging in the name of the Association that the bill be passed (**Science**, May 10, 1946).

[10] It is a mistake to suppose, as some have done, that natural scientists were virtually united in opposition to the inclusion of social science in the Foundation. Besides the testimony in the Hearings of a number of prominent scientists, including Dr. Shapley and Dr. Conant (See **Hearings**, Part I, p. 51, Part 5, p. 984), the most important evidence is in the poll taken by the AAAS of its membership in which 67% favored government support of research in the Social Sciences (**Hearings**, Part I pp. 84ff, testimony of Dr. Meyerhoff).

[11] See especially the testimony of Dr. Frank B. Jewett, former Director of the Bell Telephone Laboratories. (**Hearings**, Part 2, pp. 427 ff.). The fact that, at this critical time, Dr. Jewett has been President of the National Academy of Sciences, has been a factor of considerable significance in weakening united support for the science legislation on any basis on which general agreement could be reached. In the hearings Dr. Jewett's testimony took a position not shared by any other prominent witness. It is difficult to tell how widely it is shared by other scientists associated with scientific research in industry.

[12] Which eliminated the Division of Social Sciences.

The Army's Research Program . . .

. . . . *Maj. Gen. H. S. Aurar*

The continuance and improvement of laboratories for scientific research is of primary interest and concern to the War Department. Our program is, and must continue to be, one for preparedness; and it is your job and mine to see to it that we do not lag behind any possible enemy either in nuclear physics or in any other field of research and engineering of importance in the defense of the nation.

THE JOINT RESEARCH AND DEVELOPMENT BOARD

To assist in maintaining existing contacts and making new ones, as well as to assure co-ordination between the War and Navy Departments, the respective Secretaries have set up the **Joint Research and Development Board.** In its charter they not only gave it a "blank check" of authority but also, and more important, they obtained the services of the former head of the Office of Scientific Research and Development as its chairman—Dr. Vannevar Bush. This is a five-member board, including the chairman. The Navy members are Assistant Secretary Kenney and Admiral Ramsey; the Army members, Generals Spaatz, commanding the Air Forces, and Devers, the Ground Forces.

One of the permanent committees of the Joint Research and Development Board is the Atomic Energy Committee. The Army membership of this committee, which is now under consideration, will also link the Army with whatever agency for the development and control of atomic energy Congress may create.

Our program provides for progress in research and engineering for guided missiles, radar, biological warfare, and other modern tools of warfare. That the War Department means business in this matter is amply demonstrated by the creation at the highest staff level of a directorate for research and development. To see where this organization fits in the research and development picture, recall that on the national, or **presidential** level, there will be the Atomic Energy Commission and the National Science Foundation. In addition to many existing governmental organizations on the **cabinet** level, such as the National Advisory Committee for Aeronautics and Bureau of Standards, there is, and will continue to be, the Joint Research and Development Board created by the Secretaries of War and Navy. Within the War Department, at the **Chief-of-Staff** level, is the Directorate for Research and Development. The director reports directly to the Chief of Staff and Secretary of War. Within the War Department it initiates, allocates, co-ordinates, supervises, and assures the progress of research and development projects. But perhaps more important than its internal duties are those in connection with contact with the civilian scientists and engineers of the nation.

In June, when he established this directorate, General Eisenhower announced the War Department research and development policy. Doctor Bush felt that the new policy augured so well for the future that he sent a copy of the announced policy to each of the scientists and engineers who had been associated with him during World War II, together with a request that each co-operate during peace in the new program as they had done so well during war in the old one.

GEN. EISENHOWER'S POLICY STATEMENT

Here are some excerpts from General Eisenhower's policy memorandum:

"The future security of the nation demands that all those civilian resources which by conversion or redirection constitute our main support in time of emergency be associated closely with the activities of the Army in time of peace.

"The lessons of the last war are clear. The armed forces could not have won the war alone, scientists and businessmen contributed techniques and weapons which enabled us to outwit and overwhelm the enemy . . . This pattern of integration must be translated into a peacetime counterpart which will not merely familiarize the Army with the progress made in science and industry, but draw into our planning for national security all the civilian resources which can contribute to the defense of the country."

General Eisenhower listed five policies to be put into effect to achieve these ends.

The **first** policy is: "The Army must have civilian assistance in military planning as well as for the production of weapons." At the moment, two actions are being taken to put this policy into effect. One is the creation of a **War Department Civilian Panel** of outstanding scientists and engineers. Both the natural and social sciences will be embraced in this panel. The other is the creation of a **Strategic Committee** of the Joint Research and Development Board.

The **second** policy is: "Scientists and industrialists must be given the greatest freedom to carry out their research." In so far as this applies to the attitude of Army personnel, the Research and Development Divisions will police the policy. More concretely, the policy will apply to contractural relationship between the Army and the universities, industries, and foundations conducting research and en neering for it. Within the limits of pres laws governing government contracts, possible freedom will be given. But so thing more is necessary to implement policy. That is a change in the cont law to permit the full freedom of scientists and engineers envisaged by policy. Both the Army and Navy h urged the Congress to make such cha and bills for the purpose have been in duced.

The **third** policy is: "The possibilit utilizing some of our industrial and t nological resources as organic part our military structure in time of en gency should be carefully examined." A the moment the implementation of policy is in the purely planning stage. assistance of the War Department Ci ian Panel is badly needed in connec with this policy.

The **fourth** policy is: "Within the Ar we must separate responsibility for search and development from the fu tions of procurement and distributi This policy has been put into effect by establishment of the Research and De opment Division on the same level as Service, Supply, and Procurement D sion of the General Staff.

The **fifth** policy is: "Officers of all a and services must become fully aware the advantages which the Army can rive from the close integration of civil talent with military plans and devel ments." The implementation of t policy is an intra-Army affair. It can brought about primarily by the indoct ation of Army personnel.

General Eisenhower's final paragr stated:

"In the interest of cultivating to utmost the integration of civilian and i itary resources and of securing the m effective unified direction of our resea and development activities, this resp sibility is being consolidated in a separ division on the highest War Departm level. The Director of this Division be directly supported by one or m civilians, thus insuring full confidence both the military and the civilian in t undertaking. By the rotation of civil specialists in this capacity we sho have the benefit of broad guidance should be able to furnish science and dustry with a first-hand understanding our problems and objectives. By devel ing the policies outlined above under leadership of the Director of Resea and Development, the Army will dem strate the value it places upon science technology and further the integrat of civilian and military resources."

From a speech delivered in Los Angeles on July 26, 1946.

cience Dons a Uniform . . . .

. . . . from Business Week

der the above title Business Week *(Sept. presents a remarkably frank—not to say al—appraisal of the current situation in rican science. We here quote some interg excerpts from this article.*

rtly by design, partly by default, ral support of pure science is today st completely under military con- Its general direction is being set ilitary needs; its finances are coming military funds. The odds are getting er all the time that pure scientific rech will become, permanently, a branch ne military establishment.

xpenditures for research in pure ce, in 1938, totaled less than $40 mil- The bulk of these $40,000,000 came industry: the financial backbone of ersity research was endowments and dation grants that wore an industry ation because of their basis in gifts industrial fortunes.

e war changed all that. The universind foundation research laboratories drafted into military work and the rch scientists with them. The univers were converted into industrial-type atories concentrating on weapon lopment rather than basic discovery. the atom bomb project, abstruse as it , was primarily an engineering lem by the time the government pick- up.

ite early in the war the hope arose immense postwar benefits could be ved, particularly in industry and cine, if something of the wartime e and coordination of research could ontinued. Back in 1944 President evelt asked Dr. Vannevar Bush, direcf OSRD, to prepare a postwar plan ederal financing of science.

e main principle was soon caught in ossfire of contending parties. There three controversial issues: (1) the ee of centralized government control the program; (2) the handling of nercial benefits emerging from govent sponsored research; and (3) to a r extent, the inclusion of the social ell as of the physical sciences.

e New Dealers, labor spokesmen, and government people concerned with ce wanted to treat the research lation as an ordinary instrument of rnment. They stressed the advan- of coordination and argued for a e full-time administrator. And they ped for a general policy of dedicating f the research results to the public.

e universities were queasy. They ed the money, but they feared govern- domination of their research pros. They preferred, as the Bush report recommended, to keep the foundation a quasi-governmental affair administered by a board of scientists who would serve part time.

Businessmen were bothered by the proposed no-patent policy. They suspected that in reformists' hands the foundation program would soon undermine the whole patent system, long a favorite object of New Deal attack. For the same reason, most businessmen preferred the loose board set-up to a more centralized system.

Conservative congressmen freely predicted that federal support of the social sciences would degenerate into a program of radical propaganda. The more conservative House Commerce Committee sat on the bill long enough to prevent House action.

In the absence of any civilian program for science, the military moved in—the Navy about a year ago, the army in recent months.

Just before the end of the war, the Navy tackled this problem by setting up the Office of Research and Inventions. This year permanent legislative authorization for the agency and for the loose negotiated type of contract it uses was obtained, and ORI was reorganized as the Office of Naval Research (ONR).

As one university after another was released from its wartime OSRD and Manhattan District contracts, the Navy stepped in and arranged financing. By July, it had arranged to spend about $10,000,000. For the coming year, ONR has $45,000,000 of which about $11,000,000 will be spent at naval laboratories, about $7,000,000 for basic work in industrial laboratories, and about $26,000,000 at universities.

The financing mechanism is a loose form of nonprofit research contracts. Sometimes ONR arranges for investigation of a particular subject, but ordinarily a college or other research group works up a program of investigation it would like to pursue and brings it to the Navy. If ONR can see some possibility of ultimate results having military value, and if it thinks the institution has the men and the equipment to do the job, it will contract to support the program.

The typical contract is on the cost-plus-nothing basis covering salaries and a percentage of institutional overhead worked out by Navy auditors. ONR fights shy of financing buildings, but it will pay for elaborate equipment provided this is theoretically movable so that the Navy can keep title.

The Navy people are sophisticated and enlightened. Realizing that original research cannot be regimented, they are consciously trying to maintain a civilian feel in their outfit and to operate in much the same way that a national foundation would. But, necessarily, in approving projects they're looking for a military application, even though a remote one.

The pattern of research which this produces is suggested by the first year's contracts. About 40% of these are for studies in nuclear physics, as might be expected. Electronics is next, with 14%, while medicine and fundamental studies in the problems of guided missiles each account for a little over 10%.

The Army has been slower than the Navy in getting into basic studies, but it is moving into the field now and it packs the big bankroll. The Army research budget this year is about $280,000,000, but the largest part of this will be spent on development work at Army centers and through industrial development contracts. However, about $70,000,000 is earmarked for fundamental studies at universities.

To coordinate the two programs, a Joint Research and Development Board has been created. The board consists of four high-ranking officers, with Dr. Bush as civilian chairman. Chances are that the board's initial approach will not be allocation of subject matter between the services so much as allocation of institutions and personnel—permitting the Army to contract with certain research groups, the Navy with others.

The prospects for a civilian foundation are uncertain and becoming more so all the time. The question will certainly come up in the next Congress. But the mere fact that a research program is already going forward to the tune of $100,000,000 a year, even though under military auspices, will take away much of the urgency of the foundation proposal.

Particularly in the light of Navy patent policy, some businessmen may prefer the risk of the militarization of science to the creation of an agency they suspect of ideological motives.

And even though many scientists deplore the warping of the direction of research inevitable in a military program, some of the university people—with their fields well-established, their file of telephone numbers organized, and the money flowing freely—may hesitate to upset a going operation.

The Role of Large Laboratories in Nuclear Research

. . . . **Lee A. DuBrid**

I think I should start out by warning anyone who is expecting definite answers to the many questions concerning the place large laboratories are going to play in physics research, that he will be disappointed. My objective will be to ask questions more than to answer them.

In the past, basic research in physics has been carried on primarily in small laboratories. A research worker with a few assistants was the fundamental unit. It is true that in the larger universities and some industries, a number of these research units were assembled under one roof and under one department chairman. The units themselves, however, were reasonably independent, though the stimulation brought about by many units working near each other was of the greatest importance.

Now there were individual cases, of course, usually under the leadership of a great research figure such as a Rutherford or a Kammerlingh Onnes where the individual research units combined efforts in a cooperative attack on some major problem or field. Some of these were, of course, eminently successful. Even in them, however, independence of the individual units was the rule. Each unit built up its own equipment and facilities. In some instances, the units shared some major piece of equipment with others—such as in the famous Leyden cryogenic laboratory.

Such was the picture before 1930 in basic physics, even the basic physics carried on in industrial laboratories.

In applied science, the situation was quite different. Here in many large industrial laboratories, concentrated cooperative attacks on important problems had been organized with conspicuous success. The various aspects of the problem were parcelled out to specialized groups, each of which was responsible for the development required to bring its unit in line with the whole.

The beginnings of a change in the organization of basic science laboratories began with the development and perfection of the cyclotron as a research tool. Here was a major piece of equipment which could keep many individual research units busy. Several problems could be carried on in parallel—and the combined efforts of all groups were needed to keep the machine in operation and to carry on continued improvements. In a sense then, the "large" laboratory of the sort I am referring to today, began with the Radiation Laboratory of the University of California. Other smaller groups, built on a similar pattern, grew up in other parts of the country and cooperative research had become a reality by the time the war broke out.

A speech delivered at the Bicentennial Celebration of Princeton University.

THE HUGE WAR LABORATORIES, A SPECIAL CASE

The war, of course, brought about the greatest flowering of large cooperative laboratories in history. Laboratories numbering many hundreds or even thousands of employees grew up for the development of radar, proximity fuses, nuclear energy and other fields. Their achievements were so astounding that they at once raised the question of why peacetime research could not be carried out in the same way. This is the question which I would like to examine in more detail. There is danger of misreading the lessons taught by the war—but there is also the danger of not reading these lessons at all.

In the first place, it is necessary to emphasize the fact with which you are all familiar that these huge war laboratories were not research laboratories in the sense that they carried on research in pure physics. They were applied physics laboratories—they were built and organized to develop specific weapons of war. The basic research which paves the way had been done before the war. The tools were for the most part at hand—they had only to be put into usable form. True, many basic problems had to be examined or re-examined. Many a good Physical Review paper could have been published had security restrictions allowed. But these researches were for the most part incidental to the task of developing a weapon. These laboratories followed in many respects, the patterns which had already been set by the industrial laboratories in attacking applied problems. But they went further in size and in the degree and specialization of the groups—and in the number of physicists employed.

We cannot, however, conclude that because these laboratories succeeded in their technological job, they could also be adapted to the problems of basic research. Nor can we conclude that they can't be.

A second feature of these laboratories was that they were built up under conditions peculiar to a war—conditions which cannot possibly be reproduced in full in time of peace. During the war it was possible to drain the colleges and universities of scientists to man the laboratories. This produced serious enough results during war—it would be impossible and disastrous in time of peace. Neverthe-
less, more scientists can be trained
the availability of enough scientists
be no permanent or insurmountable ob
cle to large laboratories if they are r
ed.

Still more important—in fact the
inating feature in any laboratory pro
—is the attitude of the scientists th
selves. During the war they were wi
to live and work under necessarily
satisfactory conditions. They were
ing to be regimented (at least mos
them were) for the common good.
were willing to engage in all sorts of t
—tedious and uninteresting ones,
work—even administrative work—w
were far afield from their interests a
research workers. In short they were
ing to give up the most cherished p
ileges normally associated with scien
work—independence and freedom.
were not only willing but anxious to
up these things because the incent
were so overpowering. The opportunit
helping in a significant way to win
war reduced all other consideration
insignificance. I believe no other objec
no matter how fine it might be, can
vide the tremendous emotional stim
to collaborative effort which the war
plied. Without this stimulus, any lab
tory built along lines of the great
laboratories, is bound to collapse—jus
every single war laboratory has colla
—whether it wished to or not—soon a
the war ended.

Our lesson from the war experie
then, is that great laboratories can
successful, in the field of applied scie
in time of war. One can safely pre
that any attempt to keep going into pe
time a laboratory built up during the
for war purposes is doomed to failur
whether it be operated under civilian
military control. If great laboratories
needed in time of peace, they must be b
for peacetime conditions.

THE NEED FOR LARGE PEACETIME RESEARCH CENTERS

The first question then is whether
the field of basic science—there is a n
for something more than the individ
laboratory of pre-war days. Let me
phasize again the word basic science.
am not talking about applied scienc
about industrial laboratories or ab
military laboratories for defense p
poses. There is no doubt a need for su
laboratories—they can be successful
conditions are right. What these con-
tions are, I will come to in a moment.

But let us now ask whether in the fi
of nuclear physics, there are reasons
establishing large laboratories. I beli
there are—and the reason is simple. So

facilities required for modern work
clear physics are so large and so ex-
e that a large staff is required to
te and make full use of them, and
a few such major facilities can be
in this country.

I have no doubt that small nuclear
rs and small or medium sized accel-
s will some day be found in almost
well-equipped physics research labo-
—in universities, some industries
esearch foundations. But the huge,
power pile, the billion-volt acceler-
vill for some years to come, be found
n a few places. And it will be poor
ny to build such facilities and not
available the large research and
cal staff required to use them to
apacity. And it will be equally tragic
h facilities are not open to use by
cists throughout the country. I be-
it is inevitable that a few great re-
centers will grow up—that they
be of greatest importance in the
ce of nuclear physics.

HODS OF ORGANIZATION

they are inevitable, the question is
an they be built and organized for
num effectiveness.

h laboratories might be sponsored
anaged either by a single university,
industrial corporation, a govern-
agency or an independent non-profit
ation organized for the purpose.

ink it will be evident to this group
either an industry nor a government
y is suited to manage a laboratory
argely for basic research. Industry
ultimately seek a practical goal—
nment or military agencies are not
to operate basic research.

re is no doubt that any one of a
major universities or engineering
s could operate a major nuclear
s center. The University of Cali-
at Berkeley is now doing it. The
anding position of this University on
acific Coast, the eminence of Dr.
nce and his staff of the Radiation
atory, the warm welcome which
s and workers from other institu-
have always had, assures the success
is great center. This Laboratory
es all the conditions which we shall
presently.

Berkeley is in a unique position—
e ways than one. It is unlikely that
ttern established there can be fol-
elsewhere in the country. In the
there are many great institutions
easy reach of each other. Since it
be government funds which finance
a laboratory, it will be difficult to
one institution to operate it—and
hen, full use by other groups is not
o insure. At any rate, in two cases
ago and the Northeast—the univer-
sities themselves have preferred cooper-
ative management. So the question of the
place and success of large cooperative lab-
oratories will soon have an experimental
answer.

PROBLEMS OF THE LARGE RESEARCH LABORATORY

Without presuming to tell these labora-
tories how they should set themselves up,
it may still be worthwhile to set forth
some of the conditions which any such
laboratory must meet to avoid known pit-
falls.

These conditions are not easy to state
concisely, but at the risk of being misun-
derstood, I will risk a few remarks about
them. (Let me call your attention to the
fact that I am no authority on this sub-
ject—for as I have pointed out—experi-
ence in a war laboratory is largely inap-
plicable. I am only stating the feelings
which I think any physicist would have).

As to facilities, it should be clear that
independent laboratories will have as their
major facilities only those very large
installations which, as far as can be fore-
seen, are beyond what a single university
could contemplate operating—or which, be-
cause of shortage of material or funds,
not more than one or two universities in
any area could have. Such laboratories
should not compete with or duplicate or
take the place of strong university physics
departments. Rather—like a 200 inch
telescope—they should provide for use
by many people, facilities of an extra-
ordinary type.

As to location, there are many difficult
problems to be met. Physical facilities
such as power, water, isolation to avoid
radiation dangers, etc. must all be con-
sidered. But less tangible elements may
be even more important. To attract a
permanent staff, they must provide a
satisfactory place to live. This means
convenience to a metropolitan area with
its housing, shopping, educational and
cultural advantages. Desert isolation is
no drawing card for most physicists. Liv-
ing conditions must be positively attrac-
tive if the highest quality temporary or
permanent staff is to be drawn in.

Location near one or more strong uni-
versities is also important. Nothing can
replace the close ties to the atmosphere,
libraries, contacts with students and
other scientific companionship and other
attributes of a university. What geo-
graphical separation is necessary can be
partially bridged by official university
connections so that ties with the academic
world are real.

As to personnel, it is evident that the
establishment must not only have an ad-
equate maintenance, technical, clerical
and engineering staff, but also a perma-
nent or semi-permanent scientific staff of
high quality supervising its general pro-
gram. And this permanent staff must
attract and welcome other workers who
come in for short or long periods. The
Laboratory should offer opportunities for
many young men to come in on post-
doctorate fellowships to complete their
training and acquire research experience.
One of its important contributions to phys-
ics will be its contribution to more ade-
quate training of young men.

As to the program, the permanent staff
will need to map out the general important
lines of effort. But the program must
be flexible enough to make room for new
ideas and new lines of attack which either
the permanent or visiting staff wish to
carry out. War time regimentation can
have no part in a successful basic research
establishment.

All of these are obvious statements.
But they are no less important for that;
for the obvious is frequently most easily
overlooked. And furthermore, these are
conditions which can readily be met by
intelligent management. And if progress
in nuclear physics is important to the
nation, to the world—and to science itself
—it is important that they must be met.
The cognizant government and military
agencies must recognize that these are
not whims of crazy scientists but are part
of the necessary fabric of the atmosphere
in which science flourishes.

That these new laboratories will face
grave difficulties, no one questions. They
may not succeed. For the next few years
the shortage of scientific personnel may
prevent their adequate development or
slow it down. There are not enough
physicists at the present moment to man
all our current ambitious programs. But
our physics departments are all but clog-
ged with ambitious and able graduate
students. They will soon be flowing out
to fill many a critical gap. They will
step into opportunities which we middle-
aged gentry would have longed for twen-
ty years ago. We all witnessed what
young men could do during the war. They
will do it again.

So, I, for one, look forward with keen
interest to a great new experiment in
physics research. Those who long for
the old days with the lone worker in the
basement room with his wax and string
and glassblowing torch can have them. I
believe that the essential spirit of the
old days—freedom of inquiry, time for
thought—can be obtained even in the
pressure of great new physical and organ-
izational techniques. I shall leave it to
the fortunate leaders of these great new
establishments to justify our optimism.

The Manhattan Project Declassification Program

. . . . . . Lt. Col. W. S. Hutchin

There exists considerable confusion concerning the publication of the scientific results amassed within the Manhattan Project. In the belief that a public release, at this time, by declassification authorities might clarify the situation we requested an article on the subject for the BULLETIN OF THE ATOMIC SCIENTISTS. *The following report by Lt. Col. Hutchinson, Declassification Officer for the Manhattan Engineer District, was prepared in response to this request.*

American science is best served by the widest possible dissemination of scientific information without restriction. American national security is best served by controlling certain scientific developments in the nuclear field as they relate to the atomic bomb.

The Manhattan Project has worked out a very effective program which protects the vital secrets of nuclear science affecting national security and which still releases the basic mathematics, chemistry and physics developed on the Project during the war. One purpose of this policy is to give impetus for American science to continue its advance, not only in government sponsored and government controlled laboratories, but also in the many independent academic and industrial organizations that are the foundation of our national scientific, engineering, and industrial strength.

The first application of this policy was the release of the Smyth Report,[1] shortly after the announcement of the bombing of Hiroshima. This was written for the substantial group of engineers and scientific men "who can understand such things and who can explain the potentialities of atomic bombs to their fellow citizens. The present report is written for this professional group and is a matter-of-fact, general account of work in the United States since 1939 aimed at the production of such bombs." In accomplishing this purpose a general survey of the major fundamental developments was presented to American scientists while the detailed information which concerns national security was retained.

Continuing the fundamental policy outlined above, General Groves appointed a Committee on Declassification, composed of the senior scientists in the country, in the fall of 1945. Dr. Richard C. Tolman, Dean of the Graduate School, California Institute of Technology and now chief scientific advisor to Mr. Bernard Baruch, was the chairman. Colonel John R. Ruhoff of the Manhattan District was the non-voting secretary. Dr. R. F. Bacher, Dr. A. H. Compton, Dr. E. O. Lawrence, Dr. J. R. Oppenheimer, Dr. F. H. Spedding, and Dr. H. C. Urey comprised the committee. The purpose was to recommend the adoption of a detailed procedure to accomplish the general mission of releasing scientific information to further the national welfare where this can be done without danger to the national security.

The first report of this committee was submitted during the latter part of 1945. It was reviewed by General Groves and finally approved by the highest governmental authority in March 1946.

The general trend of this report provided for the establishment of a declassification organization project—wide in scope and manned by the very civilian scientists who have been personally concerned with developing the information that was to be presented for release. Declassification was to be accomplished by document rather than by broad fields of science. That is, each release had to be written up and carefully reviewed in detail, first by the head of the organization in which the information was developed (called a "Coordinating Organization Director"), than by a competent scientist in the particular subject concerned (called a "Responsible Reviewer"), and finally by the Manhattan District Declassification and Publications Office at Oak Ridge to check for any possible clerical slips and to provide general administration for the organization as a whole. Actual declassification was to be accomplished when these reviews clearly indicated that the information in the document fell in the category of safely releasable material as defined in a Declassification Guide which was prepared by the committee.

The present Manhattan Project declassification organization began to operate along these lines in April 1946. With a few modifications it is now doi flourishing business and had declas more than four hundred scientific technical documents by the end of tember without releasing any inform that endangers the National Secur

The precise details of the operati this organization are outlined in M **for Declassification of Scientific and nical Matters dated 1 May 1946,** wh available in Manhattan District, Engineer Offices and in the offices o ordinating Organization Directors Responsible Reviewers, for examin by authors who wish to prepare ments for declassification.

The attached chart is taken from manual. It shows the routing and d bution of the six copies of each docu submitted and generally indicates channels available to authors who wi have their papers submitted for rel

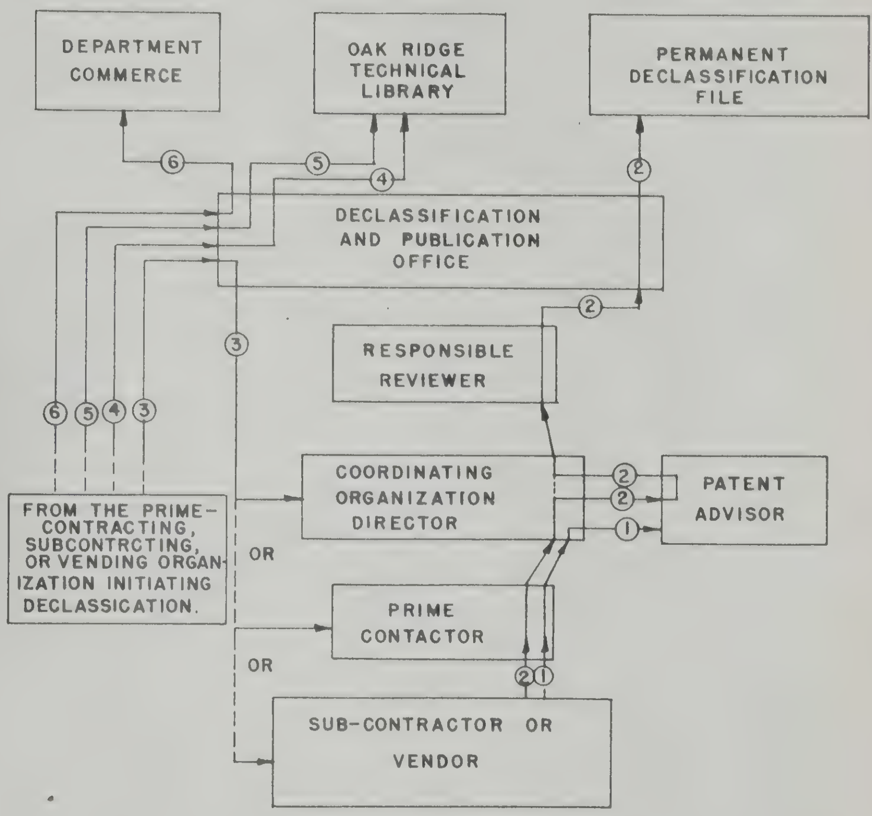
The Declassification Guide prepare the Committee on Declassification vides in general for the release of scientific information which bears direct relation to the problems th foreign nation would have in makin atomic bomb of its own. An examp physics is a paper entitled "On the integration of Nitrogen by Fast trons" by H. H. Barschall and M. E. tat. The Bibliography of Scientific Industrial Reports of the Departmen Commerce abstracts this paper as foll "A description is given of an experi using a source of monoenergetic neut of variable energy to measure the integration cross section as a functio neutron energy. The cross sections of $N(n,p)C$ and $N(n,\alpha)B$ reactions measured for neutrons of energies tween 0.2 and 1.7 Mev. Resonances observed for neutron energies of 0.55, and 1.45 Mev. Curves are appended. paper is released through the Physical view." An example in chemistry is a pa entitled, "Radio Chemistry and the Fis Products" by Charles D. Coryell. abstract of this paper is too long to peat. However, the general subject m ter is indicated by the title. A consid able expansion of the information in

1. Atomic Energy for Military Purposes, H. D. Smyth.

has been declassified and is scheduled early publication in the Journal of American Chemical Society. The of this new paper is "Survey of the on Product Isotopes" to be issued by Plutonium Project. This Survey was ared by J. M. Siegel, based partly on ious ones circulated on the Plutonium ect prepared by Coryell, Brady, Turke- Wineberg, Sugarman, Glendenin, l, Seaborg, and Kohman based on nclassified general tables of Seaborg.

ecific evidence of the effectiveness of declassification policy was given at une Meeting of the American Physi- ociety and at the September Meeting he American Chemical Society in go. Of the 101 papers presented at Physical Society Meeting, from all stic sources, 46 were the product of Manhattan Project Declassification nization. Included in American ical Society papers was a complete nd one-half day symposium on fluor- and fluorocarbon chemistry which ds the birth of a complete new h of the domestic chemical industry. represents a very considerable con- ion to American Science and was without danger to national security.

pite the carefully repeated checks are made on each document, the n operates quite rapidly on papers re clearly in the releasable category which are submitted in accordance the directions in the **Manual for the ssification of Scientific and Technical rs.** A prominent scientist at the Physical Society meeting said that remarkable that not a single paper was submitted for declassification resentation at this meeting had to thheld from presentation because of istrative failure of the Declassifica- Office at Oak Ridge. Normally a ent can be processed within two from the day that it leaves the Co- ting Organization Director's office.



NUMBERS REFER TO SPECIFIC COPIES OF THE SIX REQUIRED FOR DECLASSIFICATION

Army officer recently described the of this declassification organization national welfare by the following ation: "This war was won by team- and the two and one-half ton six drive truck. That makes the cargo truck a military weapon. Suppose that after World War I the government had declared that all future research directed toward improving cargo trucks was to be conducted in strictest secrecy. If this had been done, maybe we wouldn't have had such a good cargo truck by the time World War II came around. In science the more contributors there are, the more progress will be made. We can't release everything concerning the atomic bomb, but we can release a lot of valuable information that will help American science to advance from here, particularly in applying wartime developments to peacetime use." Thus the Manhattan Project is furthering the national welfare by releasing scientific information where this can be done without danger to the national security.

The United Nations and Atomic Energy

The month of October has brought only slow development in the UN Atomic Energy Commission. Towards the end of the month, the spotlight shifted to the UN Assembly, where the subject of atomic energy kept creeping into all the most important pronouncements.

The September controversy over the American control plan had some repercussions in October in the form of speeches and statements by Baruch, Hancock, and Wallace.

UN Atomic Energy Commission

September ended on a hopeful note with the unanimous adoption of the report of the Scientific and Technical Subcommittee (See Bulletin of October 1). This report was submitted to the "Committee 2" (which is the political committee). The latter met on October 2, with the Chinese representative **C. L. Hsia** in the chair. In a review of the preceding developments, Hsia stated:

"The Scientific and Technical Committee which began its work on July 19 held 20 meetings. Here discussion was shifted from a debate concerning policy to an examination of the Technical and Scientific aspects of atomic energy. The focus of discussion was different and the method of work was different. The object was not that of stating national policies but rather the discovery of the relevant scientific facts that could be unanimously accepted by a group of scientists. All political implications of the problem of control were excluded. The committee worked together closely and intensively in the preparation of a document upon which they could all agree. The activities of this committee have significance for the work of the commission from both a substantive and a procedural viewpoint. The committee has produced a document containing important statements of facts and they have demonstrated a method of work that might be applicable in subsequent phases of our work."

The report* was then presented by **Prof. Kramers** (Holland). Prof. Kramers emphasized that from the technical point of view the Scientific and Technical Committee did not see any objections to control over atomic energy. He pointed out that while the question whether effective control over atomic energy was possible was a political question, the Scientific and Technical Committee had considered it useful to analyze what the committee called "Elements of Control", an analysis contained in Chapters 3 and 4 of the report. Prof. Kramers stressed that the report was the result of collaboration in the full sense of the word. To scientists, he said, the limitation of information at the disposal of the committee was far from agreeable. However, the possibility to speak frankly in informal meetings had been of very great importance.

Capt. Alberto (Brazil) in praising the work of the Subcommittee, said:

"In all justice I wish to particularly emphasize the wonderful attitude of the American scientists. As far as we were concerned, our role was often to ask questions, sometimes rather indiscreet questions but for the American scientists —Prof. Tolman, Prof. Oppenheimer, as well as Dr. Bacher, Dr. Fine, and Mr. Volpe, who are among those who share the military secrets of their country—the situation is delicate and difficult. Notwithstanding, and deserving of our highest admiration, they furnished us information in keeping with the standard of truthfulness among real men of science, and all this within the limits imposed by their duty to their country."

Dr. Nervo (Mexico) pointed out that the report established the close connection between peaceful and warlike activities in the field of atomic energy. He made the suggestion that the isotope separation plant and primary reactors, which he understood to be the dangerous large scale establishments, be prohibited in individual countries, and managed instead by an international organization in a special zone under international jurisdiction. The nuclear power plant, which he thinks are more difficult to use for diversion, could be established under national auspices, subject to international control.

Prof. Kramers promised a consideration of the proposal.

General McNaughton (Canada) said: "I would suggest that Committee 2 should now develop the examination of the problem of control to a further stage by following the method which has proven so successful in the Scientific and Technical Committee. Thus we might seek, through informal or semi-formal discussion, to add to our understanding of the problem. I suggest that this next stage in our work would not involve a decision on any particular system of control."

Mr. Parodi (France) supported the suggestion that Committee 2 should stay as long as possible on the technical level, and delay the consideration of political and legal problems to a later stage of its deliberations. Further data could be collected in all countries on the systems of control operating in comparable in[...] tries, like gold mining, diamond m[...] electricity, etc.

Mr. Gromyko (USSR) said he w[...] like to have some time to study, not [...] the report but also the Canadian [...] Resolution, the questions raised by [...] Representative of Mexico, the obs[...] tions of Professor Kramers, and the st[...] ment of the Representative of Franc[...]

* * *

The Scientific and Technical Sub[...] mittee met on October 17 to consider [...] Nervo's suggestion. It was pointed [...] by Kramers that the question of [...] establishment of an international [...] where nuclear fuel production shoul[...] permitted, is a political one and as [...] outside the scope of the Subcommitte[...] was decided that Dr. Kramers would [...] Committee 2 a personal opinion on [...] subject after consultation with [...] members of the Subcommittee.

* * *

On October 18, Committee 2 met [...] Prof. Kramers made a statement w[...] said in part:

Dr. Nervo had drawn attention to [...] circumstances, that in those peaceful [...] tivities, which are directly concerned [...] the production and consumption of nuc[...] fuel (separation plants and reactors) [...] have still to distinguish between activ[...] which are "very dangerous" with res[...] to the possible diversion of material, [...] activities which are dangerous to a sm[...] er degree. He asks if this circumst[...] does not make possible a system of [...] trol by which the very dangerous ac[...] ities should take place "under internat[...] al organization and in territory sub[...] to international jurisdiction rather t[...] in national territory."

This question has clearly political [...] plications and implications of this [...] have always been outside the scope of [...] discussions in our Subcommittee. [...] we may perhaps be able to contribut[...] the answer of Dr. Nervo's question [...] the basis of the statement contained [...] our report.

Separation plants producing highly [...] centrated U-235 are certainly very d[...] gerous, but in our opinion primary react[...] or secondary reactors designed so as [...] produce significant amounts of nucl[...] fuel, together with the associated purif[...] tion plants, are not less so. Less dang[...] ous should be the hypothetical react[...] for power production mentioned in [...] report, which only consume and do [...]

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* This report was reprinted in full in the BULLETIN Vol. 2 Nos. 7 and 8.

enerate nuclear fuel, including those ch may possibly use "denatured" fuel. s possible that reactors of the latter may be built and operated some time, however promising the idea of such tors might be from the point of view ontrols, we must, in the light of our ent knowledge, just regard them as ectural possiblities for the future. It herefore difficult for us to discuss the ise danger which these reactors imply the precise degree of control which would require.

e thing can always be safely stated: tors, of whatever type, will imply danger if they are sufficiently small; small reactors will be of importance various kinds of research, for the ufacture of isotopes and radioactive rial as neutron generators, and so on. oon however as we consider reactors gned so as to develop significant nts of energy, say at a rate corres- ing to 1,000,000 kw, they will always ve considerable danger. One of the ns for this danger and perhaps the one, is that the amount of nuclear necessary for the running of such ors will be so big (say of the order kg U-235 per day) that diversion of rial on a scale sufficient for the pro- on of atomic weapons is possible.

. Nervo said that he or any other ber of the committee would possibly to this question again at a later .

ofessor Kramers said that the scien- nd technical committee had not been happy to find that so little could be on this matter now. Scientific collab- on of nations would probably find an er to this question and to other im- nt problems.

n. McNaughton (Canada) introduced olution:

at Committee No. 2 proceed to ex- and report on the safeguards re- at each stage in the production use of atomic energy for peaceful ses to prevent the possibilities of e indicated in the report of the ific and Technical Committee.

at for this purpose, Committee No. ablish an **informal working group,** sed of two members of each delega- ne of whom shall be a Scientific or nical Representative, and with rity to consult other experts in any elated to atomic energy.

at this informal working group re- ts conclusions to Committee No. 2." said:

e work might conveniently be divid- o certain distinct phases. The Scien- Report has indicated three distinct of posssible misuse, namely, diver- sion of materials, clandestine operations, and seizures of material or facilities.

"I would suggest that measures to prevent these possibilities of misuse be considered separately in relation to each stage in the production and use of atomic energy for peaceful purposes, beginning with the mines.

"Thus, in the first phase the discussion might lead to a report on various possible measures to prevent the diversion of materials from each activity in atomic energy for peaceful purposes considered in turn.

"Proceeding to the second phase, the Committee might discuss possible safeguards to prevent the clandestine operation of mines and other activities leading to the manufacture of atomic weapons. In dealing with this problem it would, of course, need to take into account the extent to which safeguards to prevent diversion of material would in themselves be effective in preventing clandestine operations.

"As a third phase the committee might discuss the problem of seizure and report on the possible measures of safeguard.

Mr. Hancock (U.S.) supported the Canadian resolution. He announced that the United States delegation would submit to Committee 2 for study a 50-page report which would deal with problems of control and which, he hoped, would clarify many problems before the committee.

Mr. Gromyko (USSR) objected against the provision in the Canadian resolution that one representative from each nation in the informal meetings should necessarily be a scientist. Resolution was accordingly amended and passed unanimously.

The available reports on the informal sessions of Committee 2, which began on October 14, are fragmentary.

On October 14, **Mohamed Bey Khalifa** (Egypt) took over the chair.

The Secretariat submitted a working paper that quoted General McNaughton's statement that the report of the Scientific and Technical Committee had indicated three kinds of misuse of atomic energy, namely, diversion of materials, clandestine operations and seizures of material or facilities. The Secretariat suggested the following outline of working program for Committee 2 within phase 1, following the sequence of activities in the flow charts appended to the report of the Scientific and Technical Committee:

(1) Uranium and thorium mines
(2) Concentration plants
(3) Refineries
(4) Chemical and metallurgical plants
(5) Primary reactors and associated chemical separation plants
(6) Isotope separation plants
(7) Secondary reactors.

The Secretariat paper stated that if this outline were followed Committee 2 would first turn its attention to the consideration of safeguards to prevent diversion of raw material in the mining and milling of uranium and thorium ores.

Sir George Thomson (United Kingdom) suggested that Committee 2 establish three panels to accelerate its work. These panels should deal with the topics listed by the Secretariat grouping them into three main categories: 1. Production of raw materials, extraction and refinement; 2. Separation; 3. Use of the material.

General McNaughton (Canada) in supporting this suggestion said that Canada was prepared to help in any way to give a picture of uranium mining in Canada.

The Committee unanimously agreed that informal conversations be held on the subject of raw materials.

This meeting was the first in which political delegates and technical advisers participated together.

* * *

On October 15, a second informal session was held. **Prof. Alexandrov (USSR)** made the proposal that a world-wide inventory of deposits of radioactive minerals be undertaken. He suggested that each nation submit full information on its resources of uranium and thorium, and pointed out that USSR can make this particularly easily because all its mines are state-owned.

Professor Alexandrov said losses incurred in the mining and milling of uranium ore were an important factor in production. He suggested that the report contain "an index of efficiency" on the loss factor.

Differences in the production of usable uranium depend largely on the techniques in different countries, he declared.

* * *

On October 17, a third informal meeting was held in which **C. S. Parsons** of the Canadian Bureau of Mines described the mining or milling of uranium at the Great Bear Lake works, and **Major O. Rangel** of Brazil spoke on the mining of monazite sands in that country.

* * *

On October 22, in a regular meeting of Committee 2, **Prof. Alexandrov** amplified his suggestions concerning the world review of raw materials.

The other delegations were mainly in-

terested to know whether the world inventory of uranium and thorium in the field proposed by Alexandrov is to be made under international auspices or will be merely a review of data submitted by individual countries. If a geological survey of the world by international geological and mining expert teams is meant, this could be a decisive step towards effective international control; if only a collection of national data is intended, without provision for checking the correctness of these data by international inspection, the proposal cannot be taken as a serious contribution towards the control problem. A statement to the press by an attache of Mr. Gromyko, issued October 25, gave the following interpretation of Alexandrov's plan:

"The Soviet delegation considers the national control to be sufficient and, therefore, it might be possible to extend discussions on safeguards in the line of national controls."

* * *

On October 24, a fourth informal meeting was held, in which **Mr. Charles S. Parsons**, Canadian Bureau of Mines, gave an outline of the safeguards at uranium refineries in Canada.

In the discussion is was unanimously agreed that in uranium refining control was not only possible but could also be effected without an unduly cumbersome organization and without undue interference with the production process.

The discussion then turned to the question of safeguards in mines where uranium is a by-product.

Mr. Fred Searles, Jr., the mining expert of the United States Delegation, made a statement on the controls and safeguards in use in by-product mines in the United States. He divided these controls and safeguards into two stages: 1. Control of the mine itself; 2. Control of the mills and concentrators where the ores are processed. Mr. Searles pointed out that the question of control of these mines was more difficult and intricate than the one of control of uranium mines proper. Diversion of uranium was on one hand more difficult in by-product mines due to the low grade nature of the ore, on the other hand diversion was made easier by the fact that by-product mines were very often exploited as open cuts. Control measures, however, were perfectly feasible without interference with the normal operation of the mine, provided there was no collusion between the inspectors and the operators.

* * *

In the fifth informal meeting, held on October 28, the United States defined the following five types of safeguards for the effective control of atomic energy to implement the resolution adopted on October 18:

1. **Accounting** for materials includes such matters as (A) materials entering and leaving a plant and materials in process and in storage; (B) auditing the accounts, and (C) validating the accuracy of the data by quantitative measurements at appropriate points in the process.
2. **Inspection** consists of adequate observation of activities wherever diversions might occur or clandestine operations might be conducted.
3. **Licensing** constitutes permission to conduct certain activities under specified conditions such as plant design, approved processes, etc. It usually implies a degree of supervision by the licensor.
4. **Supervision** involves continuous association and co-operation in day-to-day operations with those responsible for management. It implies, also, authority to insist that management comply with certain established conditions.
5. **Management** (with or without ownership) involves direct responsibility for day-by-day decisions governing the operations.

* * *

The Discussion in The UN Assembly

The UN Assembly opened on October 23 in New York. Important references to atomic energy control were contained in the speeches of President Truman (US), Mr. Noel-Baker (Great Britain) and Mr. Molotov (USSR).

President Truman said:

"Two of the greatest obligations undertaken by the United States toward the removal of the fear of war remain to be fulfilled.

"First, we must reach an agreement establishing international controls of atomic energy that will ensure its use for peaceful purposes only, in accordance with the Assembly's unanimous resolution of last winter.

"Second, we must reach agreements that will remove the deadly fear of other weapons of mass destruction, in accordance with that same resolution.

"Each of these obligations is going to be difficult to fulfill. Their fulfillment will require the utmost of perseverance and good faith, and we cannot succeed without setting fundamental precedents in the law of nations. Each will be worth everything to perseverance and good faith that we can give to it. The future safety of the United Nations and of every member nation, depends upon the outcome.

"On behalf of the United States I can say that we are not discouraged. We shall continue to seek agreement by every pos-sible means."

P. Noel-Baker (Great Britain), asse that in the view of the British Gov ment atomic energy was the most portant question that would come be the Assembly at its present session.

He solemnly pleaded with the fifty member nations to "open their fron and grant freedom of access to what extent might be required for internat inspection."

Mr. V. M. Molotov's speech on Oct 29 was in large part devoted to a nunciation of the American and prais the Soviet atomic energy plan. Howe this polemic served as an introductio a proposal for general disarma which went far beyond the problen atomic armaments. We print here section of Molotov's speech dealing di ly with the atomic bomb, but postpo report on the general disarmament de initiated by Molotov, and continued by American representative, W. R. Austi October 30, to the next issue.

Molotov said:

"It is necessary to dwell on the q tion of the atomic bomb which now p such an important part in political culations of certain circles.

"Only recently J. V. Stalin, the of the Soviet government, explained a convincing manner the views of Soviet Union on this subject. He espe ly emphasized that the atomic bomb not decide the outcome of war since omic bombs are by no means suffic for this purpose' and said also tha one is to speak of a threat to peace, tainly monopolistic possession of the cret of the atomic bomb does creat threat' against which there exist at least two remedies: (a) monopolistic session of the atomic bomb cannot long; (b) use of the atomic bomb be prohibited.' These authoritative st ments which resounded throughout whole world and met with sympath response in the hearts of many mill of people ought to be duly appreciated

"As we know there are two diffe plans regarding the use of atomic e gy. I have in mind the plan of the Un States of America on the one hand the plan of the Soviet Union on the ot

"The American plan, the so-ca 'Baruch plan', unfortunately is cha terized by a certain degree of selfish It is based on the desire to secure the United States the monopolistic pos-sion of the atomic bomb. At the s time it calls for the earliest possible es lishment of control over the productio atomic energy in all countries, giving this control an appearance of internati character, but in fact attempting to p tect in a veiled form the monopoli

ition of the United States in this field. is obvious that projects of this kind unacceptable for they are based on a row conception of the interests of one ntry and on the inadmissible denial the equality of states and their legiti-e interests.

This plan, moreover, is afflicted by ain illusions.

Even in the field of atomic energy cannot possibly count on the monop-tic position of any single country. ence and scientists cannot be put in ox and kept under lock and key. It is time that illusions on this score e discarded. Illusionary are also the es for a decisive effect of the atomic b in time of war. It is common knowl-e that the atomic bomb was used inst such cities as Nagasaki and Hiro-na. The population of these Japanese s experienced the cruel effect of the nic bomb. The atomic bomb was no-re used to deal with troops. And this ot an accident. If there are, however, s to use atomic bombs against the ian population of cities and to use n on a large scale at that, as cer-of the newspapers babble, one should give oneself up to any illusions with rd to the international effect which be produced by the realization of cious plans of this kind. Justified ntment may gain possession of honest le in all countries and the enthusiasm t the decisive effect of the atomic b in a future war may entail political equences which will mean the great-disillusionment above all to the au-s of those plans. Lastly it should not orgotten that atomic bombs used by side may be opposed by atomic bombs something else from the other side then the obvious collapse of all pres-day calculations of certain conceited shortwitted people will become all too rent. Illusions in serious matters are ys dangerous which fact will prob-be recognized both by Baruch him-and by his partners.

ll this goes to show that the truth t on the side of the American plan o mention the fact that the carry-out of this plan is in contradiction the unanimously adopted decisions e United Nations. It is sufficient to hat to carry out this plan it will be sary to upset the United Nations ter, to abandon the principle of unan-of the great powers in the Security cil which is to decide the question of tomic bomb. Is it not because there desire to give a free hand to the nippers of the atomic bomb that one is raising such a hubbub around eto?

ll this goes to show that the Baruch does not meet the interests of the United Nations both as far as its substance and form are concerned.

"There is a different plan for the atomic bomb, the plan suggested by the Soviet Union. This plan is based on entirely different lines.

"We, the Soviet people, do not tie up our calculations for the future with the use of the atomic bomb. I would recall that the General Assembly has already declared for the exclusion of atomic weapons from national armaments. Therefore there is no reason to postpone the adoption of an international convention proposed by the Soviet Union regarding the banning of the manufacture and use of atomic weapons. Only by adopting such a decision will we create conditions favorable to a free and fruitful examination of the questions relating to the establishment of control over atomic energy in all countries.

"It was after the first World War that the nations reached an agreement to prohibit the use for military purposes of poisonous gases, bacteriological means of warfare and other inhuman implements of war. It is all the more necessary to prohibit the use for military purposes of atomic bombs as well as any other means of mass annihilation of people which in this particular case means the wholesale destruction of the inhabitants of cities and civilians in general when a merciless blow will mainly fall on children, women, sick and old men. Those who yesterday fought against aggressors and who are the true opponents of new aggression should consider it their sacred duty to outlaw the use of atomic bombs and to arrange for the use of the discovered atomic energy exclusively for peaceful purposes. Only such use of atomic energy will receive gratitude from mankind as a just solution. The honor and conscience of freedom-loving people demand that the atomic bomb be outlawed, for the United Nations will never assume the responsibility for any plans to use atomic energy for the purpose of wholesale destruction of people and in general to use it to the detriment of mankind.

"Our disputes in this case were probably inevitable owing to the novelty of the question, but in this case, too, we must avoid the division into two camps; into that of militant atomists on the one hand and that of the advocates of the use of atomic energy exclusively for peaceful purposes on the other. We should therefore, believe that the exchange of views on this subject which has been started will in the long run result in a unanimous opinion among the United Nations including the United States.

"Otherwise what would people think and what would we reply to their perplexed questions?

"The other day you may have read in the New York papers the speech made by Mr. Baruch who was fairly outspoken as regards his views on war and peace. On October 12th at the College of the City of New York he stated: 'Peace seems beautiful during the savagery of war but it becomes almost hateful when war is over.' Further in the speech Baruch was not sparing of words in expressing his love for 'freedom.' But it is easy to guess that his conception of freedom is far removed from the real aspirations of common people for freedom, well being and lasting peace. He would like to see all people satisfied with the freedom under which only the lucky ones can enjoy the benefits of life not only in time of prosperity and peace but amid the conflagration of war. His sentiments are alien to the people who sweat in heavy daily toils or who with their own hands and at the cost of their life defend the freedom and future of their native country. Otherwise public men belonging to his class too would have to agree that in our time the so-called 'common people' are mostly concerned that their governments and their statesmen should see their main task in the defense of peace and security of nations because after all the trials of the Second World War the striving for security and lasting peace is the innermost sentiment of common men and women throughout the world.

"Far reaching plans connected with the atomic bomb are perhaps dictated by the very same philosophy which finds its expression in the words: 'Peace becomes almost hateful when war is over.'"

* * *

The four proposals with which Molotov ended, included, under Nos. 2 and 3:

"2. The implementation of the decision on the reduction of armaments should include as a primary objective the banning of the manufacture and use of atomic energy for military purposes.

"3. The General Assembly recommends to the Security Council to provide for the practical achievement of the objectives set forth in the above mentioned paragraphs . . ."

The passage from the speech of Mr. Baruch which Mr. Molotov used to attack him as a warmonger, ran as follows:

"Peace seems beautiful during the savagery of war, but it becomes almost hateful when war is over. Each disputant then demands a peace made in his own image instead of a peace acceptable to all. But there are some things more precious even than peace, and the greatest of these is Freedom."

Baruch and Hancock Defend the American Plan

The "Baruch plan" has been under attack from two sides. The Soviet crticism has just culminated in the vicious attack on Mr. Baruch by Foreign Minister Molotov (in the speech reprinted elsewhere in this issue). This attack is directed against the very principle of an International Atomic Development Authority, and also, although less consistently, against international inspection. The domestic criticism, voiced most forcefully in Mr. Wallace's letter (reprinted in the last issue of the Bulletin) accepts fully the fundamentals of the American plan, but suggests abandonment of the request for the abolition of veto power in cases of violation of the atomic energy convention, and generally advocates a less rigid attitude on the side of the American delegation.

During October, Mr. Baruch and his colleagues have, on several occasions, vigorously defended the American plan, refusing concessions to either foreign or domestic critics. They als jected Mr. Wallace's suggestion of a voluntary interruptio American bomb production as a gesture of good will. In they used a somewhat contradictory argument, asserting in the first place, no country can be asked to renounce unil ally its most decisive weapon, and in the second place, cess of bomb production will be an empty gesture unless the pro tion of fissionable materials is stopped, too. The latter request which nobody has made and which the Soviet deleg in particular, cannot make as long as they refuse to dis the control of atomic energy, and insist on dealing only the outlawing of bombs.

Because of lack of space, we can reprint here only the important passages from the authoritative pronouncement Mr. Baruch and his colleagues.

In receiving the Freedom House plaque from the hands of Mrs. Roosevelt on October 8, **Mr. Baruch** said:

"The plaque reads: There must be no veto for those who violate their solemn agreements."

" . . . I am happy that Freedom House chose this text, for it exemplifies one of the weightiest points in the American attitude—the non-application of the Great Powers' veto to protect offenders, once a treaty of prevention and punishment dealing with atomic energy has been agreed upon. Our proposal is concerned with the veto power only as it affects this particular problem, and not with the general veto written into the structure of the United Nations.

"America asks nothing she is not willing to give. All of us must make contributions.

"But I would be recreant to my trust if I dared to recommend the immediate abandonment of a major weapon in our arsenal—the bomb. How can any one ask destruction of existing bombs unless their further manufacture is effectively prohibited? Why should America alone be asked to make sacrifices by way of unilateral disarmament in the cause of international good will?

"I now say that America stands ready to proscribe and destroy the atom bomb, if the world will join in a pact to ensure the world's security from atomic warfare. But it must be a realistic working pact—not merely a pious expression of intent, wholly lacking in methods of enforcement.

"The Soviets protest that inspection violates national sovereignty. Better that—than international disaster. America is willing to accept inspection as a control measure and for some time America would be the most inspected.

"I am at a loss to understand why national sovereignty should be made such a fetish. Other international processes require the presence of officials of one nation within the territory of another; they include customs, mails, treatment of war prisoners, and so forth. Every treaty involves some diminution of absolute national sovereignty, but nations enter into such treaties of their own free will and to their common advantage. Indeed, freedom to enter into such voluntary international arrangements is inherent in the very concept of national sovereignty.

"Here are the irreducible minima essential to the effective control of atomic energy:

1. Control through an international agency of the production and use of uranium and thorium, of fissionable materials, and of their products to the extent necessary to ensure their use for peace and prevent their diversion to war. The control must include:
   a. Free access for international inspection sufficient to prevent unauthorized activities in atomic energy or to detect them soon enough to protect complying states against the hazards of violations and evasions.
   b. Sufficient control of each step in atomic energy production to prevent diversion for illegal purposes.
   c. An international agency with resources and authority adequate to carry out its day-to-day responsibilities.
   d. Provision for the international agency to lead in atomic energy research so as to make it an aid to social purposes and carry out effectively its preventive operations.
2. Prohibition, including provision for swift and certain punishment, of the following activities:
   a. Illegal possession or use of an atomic bomb.
   b. Illegal possession, or separation of, atomic material suitable for use in an atomic bomb.
   c. Seizure of any plant or other property belonging to or licensed by the international control authority.
   d. Willful interference with activities of the internati control authority.
   e. Creation or operation of dan ous projects in a manner trary to, or in the absence license granted by the inte tional control body.
3. Transition to full international trol by successive stages to be cifically set forth in the treaty agreed to by all. The stages be so designed as to be fair and table to all nations; they must the system of safeguards fully being as rapidly as possible; and must not endanger any nation's curity in the event of a breakd during the process of transi under the treaty.
4. Provision that no nation which accepted the international co treaty can be protected from pu ment for violation of its te through use of a veto whether by the violating state or by any o nation.

"In the elimination of war lies our solution, for only then will nations c to compete with one another in the duction and use of dread 'secret' weap (atomic, biological, bacteriological, and others), which are evaluated so by their capacity to kill. That devi program takes us back not merely to Dark Ages but from cosmos to chaos. we succeed in finding a suitable way control atomic weapons, it is reason to hope that we may also preclude the of other weapons adaptable to mass struction. When a man learns to say he can, if he chooses, learn the rest of alphabet."

In addressing the convention of American Life Insurance Co. in Chic on October 11, **Mr. Hancock** said:

"The January 24, 1946 resolution of General Assembly of the United Nati directed the Commission to make spe proposals '**for control of atomic energy the extent necessary to ensure its use for peaceful purposes and for effec**

guards by way of inspection and other ns to protect complying states against hazards of violations and evasions.'

t would have been so easy for the mbly to follow the old practice for ling such problems. It would have easy to require the Commission to a resolution simply outlawing ic bombs. Apparently the Assembly in mind all of the efforts over the s to outlaw various implements of all of which had proven their dismal ectiveness. It has been clear from the that the least that can be sought is dequate warning to the world of any ned evasion of an atomic energy y, and that this warning should be y enough to protect the world nst a surprise attack.

his treaty is to follow a new pattern, thing never attempted in the world e. This is to be a treaty which the l will know is being kept, or which world will know is not being kept, thus ing the punishment of the violators early date.

he United States plan—while it may e those who seek the easy, the con- onal solution—is surely a realistic oach to the hard facts of the problem. nforms not only to the facts and the of the situation but also to the man- of the General Assembly which speci- solution based on proposals for con- and effective safeguards.

brief, the United States has pro- an international authority with un- ocal power to exercise full and effec- ontrol over atomic energy from birth ath and a system of swift and certain hment for violations which shall be atized as international crimes.

believes that a willingness of nations omit to inspection by an international is the best evidence of honorable ions not to use the bomb and also ake only the proper peacetime uses omic energy. It also believes that un- the Authority has power to report ctions and to initiate punishments, whole international control plan will re words, and become a fraud upon eople of the world.

the nations of the world should de- upon an international authority with esponsibility to prevent the making bomb, while at the same time giving mpetus to the peaceful uses of atomic y; if they will give an international ization the requisite powers to dis- e this responsibility, with the right ow what is going on in the atomic y field anywhere in the world, with to enforce its everyday operating ons, with power to bring offenders a bar of international justice, and he creation somewhere in the United ns organization of adequate power nish; if these decisions can be made —then it should not be too difficult to state when or under what conditions the United States will cease making bombs, and ultimately when and under what conditions it will dispose of its existing stock of bombs and bomb materials.

"However, it seems futile even to discuss the conditions under which these two events would take place unless a decision has been arrived at to create an effective plan of controlling atomic energy, the minimum essentials of which in the United States proposals include:

1) An international control body with adequate powers;
2) A system of inspection based on free access; and
3) Appropriate provisions for preventions and punishment, without recourse to the veto.

"It has been argued that it would be a great gesture of good will on the part of the United States, which would further the negotiations toward the control of atomic energy, if the United States were to agree to stop making bombs at this date and were to announce this decision. In my opinion, that is a very superficial view of the problem. The suggestion essentially is for unilateral disarmament so far as this nation is concerned. No other nation has as yet offered even a minimum of disarmament, let alone the elimination from its arsenal of any comparably powerful weapon. However, let us suppose, for the sake of argument, that this country were to announce that bomb manufacture had ceased. This would lead to demands as to how many bombs we have stockpiled and probably also to demands for the right to inspect our manufacturing plants to ensure the world that we had in fact stopped. In the present state of mind of the World, it wouldn't be too fanciful to assume that we had already accumulated such a stockpile of bombs that we already had enough for any contingency. Certainly this charge would be made and with some plausibility by those who were not convinced of our good faith.

"The suggestion of merely stopping the manufacture of bombs is a thoroughly impractical one unless it were accompanied by the stopping of the manufacturing of the fissionable materials themselves. If this were stopped, the result would affect adversely the development of atomic energy for peaceful purposes.

"Furthermore, it must not be forgotten that many nations would lose the sense of security they now enjoy because of the U. S. possession of the bomb. I assure you, gentlemen, in all sincerity that we have been deeply moved by the expression on the part of many nations of the faith and sense of security they feel in our possession of the bomb.

"Finally, if the United States, by itself, were to agree now never to use the bomb under any possible condition—and nothing less than that would apparently suit the proponents of the idea—it seems entirely clear that we would never be able to secure an effective plan for controlling atomic energy.

"There has been a great deal of discussion about our idea concerning the veto. There seems to have been an entirely unwarranted assumption that we were making a general attack upon the veto, now in the power of the Big Five members of the Security Council. Nothing could be further from the fact. From the start, we have insisted on only two points which would come into being after the treaty has become effective:

"First: That the veto power now in the Security Council must be used to protect violators of the crimes which we describe in general terms as the "production or use of an atomic bomb," and which would include such preparatory steps as unwarranted possession of atomic material suitable for use in a bomb; seizure of any plant belonging to the Authority; or any wilful interference with the Authority's operation. These crimes are not such as would certainly lead to war in all cases. There seems nothing controversial about setting up these acts as crimes and providing a certainty of punishment for them, particularly since the treaty involving atomic energy will be submitted to the nations of the world who will have their chance to refuse the treaty in its entirety, including the provision eliminating the veto. In this field of crime, all we ask is that no nation be free to protect a violator from the penalties established for his crimes.

"Second: One other field of operation likewise should not require unanimous consent: The day-to-day operations of the international authority should not require unanimous approval and should not be thwarted by the desire or determination of any one nation.

"In all my search to get at the root of the questions about the veto, I have not found a satisfactory ground for objection to the United States plan. I know the claim is made that the veto issue is not relevant and also the claim is made that it was bad timing to raise this question so early in discussion. We knew perfectly well that the suggestion would not be welcomed by all the world, but realizing the necessity for it and seeing no valid objection to it, we proposed it frankly at the first session of the United Nations Atomic Energy Commission.

"It is obvious that many nations having deposits of uranium and thorium would never consent to turning these materials over to nations for peaceful use or war use, if the nations receiving the materials were left free to decide which use they

were going to put the material to and, particularly, if the nation receiving the material were to be free from punishment at the whim of any one of the Big Five. Perhaps the confusion comes from a failure to understand that this treaty governing atomic energy is to be a treaty of a different nature than any treaty, which will not depend on the conscience of any nation for its observance. The world will know whether the treaty is being observed and in the event of failure will be able to take appropriate action. In every treaty so far proposed in history, there has been no provision for the world to know that a nation intends to violate its solemn covenants, and there has been no plan of punishment short of war itself. This treaty governing atomic energy must be such that no nation may undertake a misuse without, at the same time, the world becoming aware of its attempt, and without subjecting itself to appropriate and prompt and certain punishment. Under the old pattern of treaties, it would be perfectly right to say that the veto was not relevant to the present discussions. But this is not to be that kind of a treaty.

"That's our whole position on the veto.

"All of the documents comprising the United States plan are available as a matter of public record. However, let me tackle a few public misconceptions:

"We are not trying to tear down the United Nations structure, but are determined to strengthen it.

"We have no alternate plan to recommend in the event we fail.

"We have not considered any other plan because we were told by the Assembly of the United Nations to do this one job.

"We have not asked other nations to disclose during the negotiations their uranium and thorium resources. We have not proposed that other nations refrain from research on the atomic bomb during the time we are to be free to carry on such research.

"We have at no time proposed that we turn over our knowledge of atomic energy only when the international control and inspection system is working 'to our satisfaction,' nor have we proposed to dispose of our bombs only 'at our unfettered discretion.' We have proposed, specifically, that when an adequate system for control of atomic energy, including the renunciation of the bomb as a weapon, has been agreed upon (by all) and put into effective operation and condign punishments set up for violations of the rules of control which are to be stigmatized as international crimes we propose that:

1. Manufacture of atomic bombs shall stop;
2. Existing bombs shall be disposed of pursuant to the terms of the treaty; and
3. The Authority shall be in possession of full information as to the know-how for the production of atomic energy.

"We have not opposed national legislation which would make individuals liable to punishment for any of the crimes which we have enumerated. We have said that national legislation alone is not sufficient because such legislation does not make nations responsible or subject to penalty."

* * *

The following statements were made at the Herald-Tribune Forum on October 29:

Mr. Baruch: Frequently the American delegation has been asked why we're not ready to accept the Russians' convention or treaty to outlaw the bomb and destroy our present stock. The answer is simple: We are ready to accept it. In fact, we originally proposed a similar plan, but only as a part of the whole. The treaty that will save the world must be realistic in its workability and effectiveness, instead of merely an expression of pious intent.

Let this always be in your minds:

Production of atomic energy for peace or war is the same up to a certain point. Produced for peaceful purposes, it is 75 per cent on its way toward the atomic bomb and destruction. So that it shall not be diverted to war, it is necessary, through an international atomic agency, to begin at the raw materials and to use every device of control, including licensing, inspection, accounting, operation and management as protective measures.

When all this is agred upon by a treaty in final form, all our know-how, stock of bombs and raw materials will be turned over or disposed of in accordance with the treaty, which, of course, must be ratified under the constitutional processes of each nation.

I wish it were in my power to make it crystal clear that the United States has no ulterior motive—that it desires to serve the world and, in so doing, serve itself. We are, as we have been, ready to give thought to any suggestions that seek this goal. But there will be no surrender of the bomb unless and until we know that all other countries are prevented from doing the very thing we would be giving up—bomb making. Are we to be the only ones to disarm? That way is suicide.

Mr. Hancock: The Authority must have power of inspection, first, in order to make certain that all activities under its control are being carried out properly, and second—and more important—in order that any attempted illegal action by a nation or individual can be detected promptly and appropriate corrective measures taken.

The power of inspection must include the right of free access anywhere i[n the] world. Without free access inspe[ction] would be meaningless.

It is difficult to see how any nation w[hich] sincerely desires an effective contr[ol of] atomic energy can object to inspectio[n;] not only is inspection indispensab[le to] such a system but it is also a m[eans] whereby nations may prove their si[ncer]ity.

Mr. Eberstadt: I would like to em[pha]size two points:

In the first place, it is not safe to [em]bark upon this enterprise until the e[ntire] project has been carefully progra[mmed] and wrapped up into a "single pack[age]" in a treaty freely agreed to and acc[epted] by all participating nations. We ca[nnot] get part way through the process or find that we have taken some action w[hich] will be used to the detriment of this [and] other peace-loving nations.

The second point is that, once we [have] agreed to the terms of the treaty, we [can]not—indeed we cannot in equity—r[etain] in our hands sole determination of [when] each stage has been completed and [the] next is to begin. This determination [must] be left to an international body, pr[efer]ably the United Nations, where other [na]tions as well as ourselves will pass [a] judgment on the questions involved.

Gen. Farrell: We are prepared to [dis]close full information on atomic en[ergy] once a truly effective international sy[stem] of control has been established. Com[mon] sense demands that this be done, how[ever,] only when we—and by we I mean [the] world—can be sure that no nation ca[n use] this knowledge to produce atomic bo[mbs.] This is the real security we seek, no[t for] ourselves alone but for the world.

Here are some answers given by [Mr.] Baruch and his colleagues to ques[tions] from the members of the Forum:

Q—Why doesn't the United States [im]mediately announce cessation of the [man]ufacture and stockpiling of atomic bo[mbs?] Wouldn't this action on our part [be of] tremendous help to the negotiations? — (by Mr. Hancock) I think the sugge[stion] overlooks every demonstration al[ready] given of the sincere desire of this co[untry] to outlaw the use of the weapon. Our [al]condition is that if we were to outla[w its] use, it must not be possible for any o[ther] nation to produce an atomic weapo[n to] use on this or any other nation.

The suggestion is a thoroughly m[ean]ingless one, unless it were accompani[ed by] the stopping of the manufacture of [fis]sionable materials themselves and [the] dismantling of our installations and f[acil]ities. To do these things would adve[rsely] affect the development of atomic en[ergy] for peaceful purposes which we and [the] world are anxious to foster.

Q—*The Atomic Development Auth[ority] idea is a step toward world governm[ent]*

can this kind of solution be effective s we go the whole way? A—(by Mr. stadt) It may very well be that a l government may be the only final on to the problems of international ons. Under a world government it be possible to abolish war itself. the most ardent supporters of l government, however, will recognize the goal is a long way off. As Mr. ch has stated, "If one learns to say e can learn the rest of the alphabet." ut it another way, however, the letter comes before the rest of the alphabet. feel that the successful establish- of a truly effective Atomic Develop- Authority will serve as a pilot plant oader and more inclusive internation- reements. If a fully effective A. D. A. be brought into being and if nations e world can come to co-operate will- and constructively in this one enter- then we will have learned "A" and roceed to learn the rest of the alpha-

-Has there been any change in the d States policy as laid down by Mr. ch on June 14? Is any major modifi- of this plan possible? A—(address- Mr. Hancock, but Mr. Baruch volun- l the answer.) Of course modifica- are possible. Our proposals are r stubborn nor inflexible except in- as the facts of these problems them- are stubborn and inflexible. We do ish to dictate to any one; however, cts dictate to us all. We stand ready, said on June 14, to accept any es that are helpful to our general se, but that purpose must be a true on to the problem imposed upon us, erely the alleviation thereof. When that we cannot accept a mere con- n, I say so because a convention is ution to our problem. When I say nnot accept a convention, I feel that k not only for the American people r all peoples of the world who want who demand an effective control of e energy.

What has been accomplished in the of the negotiations to date? Is there eason to hope that a satisfactory nent can be arrived at soon? A— Ir. Eberstadt) Since the beginning negotiations on June 14, a number gs have been accomplished. (1) The l States proposals have been pre- and elaborated in some detail. (2) oviet proposals have been made and ated in some detail. (3) All dele- have had full opportunity to ex- their views. (4) Turning to the facts of the problem, the Scientific echnical Committee was able to re- unanimously the conclusion that was no reason to believe from a fic point of view that control was chnologically feasible. (5)The Commission's Committee on Controls has undertaken a discussion based on the facts agreed to in the report of the Scientific and Technical Committee. When one considers the tremendous complexity of the problem, I submit that real progress has been made. If discussions are continued on the basis of agreed facts, there is hope that the negotiations may be successful. When an agreement may be reached is another question. No one is in a position to say. We must all have patience.

Q—*If any great nation is adamant in its opposition to an A. D. A. would a treaty to which a large majority of the other nations subscribed be desirable?* A—(by Mr. Hancock) Our job is to secure a treaty establishing an international control agency to which all nations can subscribe. If some nation, or nations, should prove unwilling to enter into the sort of treaty we propose, then we shall have failed; and some other action by our government would be necessary. We are not in the business of thinking up alternatives. Some one else will have to do that, if and when the time comes. Any alternative which excluded any major power, or powers, would have to be quite a different one from the one we have proposed.

Stalin for International Control

Stalin, (in his answers to questions submitted by Hugh Baillie, of the United Press, on October 28) gave the following views on the atomic bomb:

Question: Has Russia yet developed its own atomic bomb or any similar weapon?
Stalin: No.

Question: What is your opinion of the atom bomb or a similar weapon as an instrument of warfare?
Stalin: I already gave my evaluation of the atom bomb in a well known answer to Mr. Werth.

The answer to which Stalin refers was given on September 24 and disparaged the atom bomb as "not as serious a power as certain political persons are want to think" and as a "means to frighten the weak-nerved, but unable to decide the fate of war."

Question: How in your opinion can atomic power best be controlled? Should the control be created on an international basis and to what extent should the powers sacrifice their sovereignty in the interest of making control effective?
Stalin: *A strong international control is needed.*

It will be noted that Stalin evades answering the second half of the question. If the answer means anything, it is a repudiation of the thesis of exclusively national control so stoutly defended by Gromyko in the UN Atomic Energy Commission.

International Research Laboratories Discussed by the Economic and Social Council

On October 3rd the proposal of the French Delegation that the Secretariat, in consultation with UNESCO should submit a report on the problem of establishing United Nations Research Laboratories was adopted by the Economic and Social Council.

Specific reference was made to the great advance achieved in the field of atomic research by international cooperation during the war.

Mr. Henri Laugier, Assistant Secretary-General for Social Affairs pointed out that the proposal did not call for the actual establishment of United Nations Research Laboratories, but merely urged that all possible information should be collected and that the possibility of establishing such laboratories should be examined.

A number of delegates spoke in favor of the proposal, stressing the fact that since all that was suggested was a survey and report, there could be no good reason for opposing it.

Mr. Nikolai Feonov (USSR) contended that the French proposal went further than merely asking for a survey.

He quoted Paragraph 1 of the Resolution which states:

"1) That a certain number of research activities can only be conducted . . . on an international scale . . ."

Mr. Feonov said that he saw there a clearly defined idea that as a natural development of national research activity there would follow combined international organizations.

He maintained that if the United Nations set up such laboratories as those envisaged it would become an "enormous international business" because the idea would be carried over into other fields. This he said would result in its becoming so cumbersome, and involve it in such vast expenditure that the Secretariat would not be able to carry on its proper functions.

Later, in answer to Dr. Lev Medved (Ukraine) who added his weight to the Soviet argument, Mr. Parodi asked whether the Ukranian delegate would, or would not, like to see research similar to atomic research, conducted on an international level.

The remark was not taken up and Dr. Andrija Stampar, President, called for a vote.

The USSR and the Ukraine voted against the proposal, which was adopted by 14 votes to 2.

New Government Agencies . . .

Atomic Energy Commission Appointed

On October 28th, the President made the following announcement:

"I have today named David E. Lilienthal Chairman of the Atomic Energy Commission, and his associates on the commission, Robert F. Bacher, Sumner T. Pike, Lewis L. Strauss, and William W. Waymack.

"Together these men—each of whom has distinguished himself in his public and professional career—will bring to the work of the commission abilities and experience which will command the confidence of the country. We may be grateful that they have been willing to set aside all personal considerations, and to take, as members of the commission, responsibilities as great as any men have ever assumed in peace time.

"The commission will take over properties and an organization which in magnitude are comparable to the largest business enterprises of the country. There is no activity—government or business—upon which the security and the enrichment of our nation are more heavily dependent.

"During the war the Army was charged with responsibility for atomic energy, and under General Grove's guidance the Manhattan District carried the project forward with brilliant success. Now, in accordance with the Atomic Energy Act of 1946, the entire program is to be transferred to the new commission. It will continue to move forward with the complete cooperation of the military and civilian personnel of the Manhattan Engineer District and all its many contractors, and with the full support of the War and Navy Departments.

"The commission obviously must have a period of time in which to study the present program in detail, to analyze the broad scope of the problems facing it, and to lay plans for carrying out its very great responsibilities. The orderly transfer of functions and properties from the Manhattan District may well extend over a period of months.

"Discussion of the preliminary steps is already under way and the transfer will be accomplished as expeditiously as possible. During the period of transition, however, the commission has asked the War Department to continue to carry on functions and operate facilities of the Manhattan Project, so that there will be no interruptions in work while the actual transfers are being carried out. To this arrangement, which meets with my approval, the Secretary of War and General Groves have agreed.

"Under the broad charter and the general policies which the Congress has formulated in the Atomic Energy Act of 1946, we look to this commission to develop and carry on an ever-expanding program through which the benefits of atomic energy may be realized.

"We recognize that the full measure of these benefits cannot be achieved without the establishment of adequate international controls. We must therefore, always be mindful that the most important step in realizing the promise of atomic energy for ourselves and for the world is the successful conclusion of the negotiations which are now in progress in the Atomic Energy Commission of the United Nations. Chairman Lilienthal and his associates, through their effective administration of our atomic energy program, will be of material assistance in advancing us toward that goal."

* * *

According to the McMahon Bill, the commission is to nominate its General Manager, and the President is to appoint a 9-man General Advisory Committee—a body which, it is hoped, will include a number of scientists.

* * *

The following are short biographical data on the members of the commission:

David E. Lilienthal

Lilienthal is Chairman of the Tennessee Valley Authority, and was Chairman of the State Department Board of Consultants on Atomic Energy.

From 1931 to 1933 he served as a member of the Wisconsin Public Service Commission. In this position he first attracted attention by his insistence of lower utility rates and more widespread use of electric power.

He was appointed a Director of the newly-created TVA in 1933. As a Director of the TVA he was charged specifically with the development of its power program and much of the TVA success in broadening the use of electric power by consumers in the valley is credited to him.

William W. Waymack

Waymack, Editor of the Des Moines Register and Tribune since 1942, has been connected with that newspaper in various positions since 1914.

Newspaper work brought him the Pulitzer prize for distinguished editorial writing in 1937. Waymack has served in numerous government capacities. He is a Director of the Federal Reserve Bank, Chicago; served as special adviser of the State Department in 1942, and as an associate public member of the national War Labor Board in the same year. He also served as a consultant of the War Food Administration.

He is a Director of the Car
Endowment for International Peace
American Association for United Nat
Freedom House, Inc., the Woodrow W
Foundation, and the National Confer
of Christians and Jews. Recently he
a member of the Allied Commissio
observe the Greek elections.

Sumner T. Pike

Pike served from 1940 to 1946 as a
ber of the Securities and Exchange
mission, and has held various other
ernmental assignments. He was advis
the Secretary of Commerce in 1930-4
a member of the Temporary Nat
Committee in 1940-41.

From 1920-22 he was Vice-Pres
of the Equipment Sales Co. of D
Tex., and Kansas City, Mo.; was S
tary of the Continental Insurance
from 1923 to 1928, and Vice-Presiden
Director of the Case, Pomeroy & Co.,
York, from 1928 to 1939.

Robert F. Bacher

Bacher is the only atomic scientist
the youngest member of the newly
pointed commission.

At present Professor of Physics
Director of the Laboratory of Nu
Studies at Cornell University, he
associated with Dr. Robert Oppenhe
at the Los Alamos laboratory in
Mexico, where the first atomic bomb
exploded.

He received a Bachelor of Sc
degree from the University of M
gan in 1926, and a doctorate in 1930.
advanced studies at the California I
tute of Technology, the Massachusett
stitute of Technology and Michigan
became an Instructor at Columbia in

In 1937 he went to Cornell where he
successively Assistant, Associate and
fessor of Physics. He is the autho
numerous scientific papers on atomic
ergy and related subjects.

Lewis L. Strauss

Strauss, like Lilienthal, brings to
commission a familiarity with the p
lems of atomic development and use.

As naval reservist called to active
as Chief of Ordnance Inspection, a
before Pearl Harbor, he served as a N
member of the Army-Navy muni
board and as a member of the I
departmental Committee on At
Energy.

Interested in the peacetime uses of
omic energy, he was active in isotope
search before the war for use in ca
therapy. He is a director of the Insti
for Advanced Study at Princeton and
Memorial Cancer Hospital of New Yo

During World War I he served as
vate Secretary to Herbert Hoover
with the U.S. Food Administration
American relief overseas.

ional Commission UNESCO Named

accordance with the UNESCO char- which provides for the creation of nal commissions to support the activ- of the Council, a commission of 100 ers is to be formed in America. Of the names of 86 were announced ptember 18 and 19 by the Assistant tary of State, W. Benton.

se members include:

ederal Government Representatives, ong them: General Omar Bradley terans Administration), Luther H. ns (Librarian of Congress), John Studebaker (Commissioner, U. S. ce of Education), David E. Finley rector, National Gallery of Art), mas Parran (Surgeon General), Al- nder Wetmore (Smithsonian Insti- on).

lembers at Large", (2 still to be ap- ted), among them: Chester Bowles, I. Cherrington (Social Science Foun- on, University of Denver), A. H. npton, Mrs. M. McAffee Horton esident, Wellesley College), A. Mac- h, Edward R. Morrow, Mrs. Anna enberg, Beardsley Ruml, John Hay tney.

presentatives of State and Local Gov- ments, (One still to be appointed), ong them: R. A. Beale (Director, Y. Public Library), Milton Eisenhow- (President, Kansas State College), A. Dykstra (Provost, University of fornia), R. Gustavson (Chancellor, versity of Nebraska), G. Stoddard esident, University of Illinois).

presentatives of Organizations, (11 to be appointed). Only five among n can be classed as natural scien- : J. B. Conant (Chemist, represent- American Association for the Ad- cement of Science), R. G. Harrison ologist, representing National Aca- y of Sciences), and D. Bronk (Phys- gist, representing National Research ncil). The Commission has the right vite ten additional organizations to representatives, and this may per- enlarge the obviously totally in- quate representation of the natural nces.

following comment by W. J. Mur- from an editorial in the "Chemical Engineering News", organ of the can Chemical Society:

glance through the recently released ninety members of the National ission on Educational, Scientific, and al Organization discloses the rather raging fact that with a few notable ions natural scientists are conspicu- their absence. Such slighting of tural sciences, in this day and age, r intentional or otherwise, is in- excusable. Among the truly great forces that prevail today, science is the one that has progressed farthest along the path of international cooperation and under- standing. Natural scientists have been and still are, despite the temporary conditions forced upon them by World War II, the most internationally-minded group in the world today.

"We believe that the present paucity of natural scientists on the American UNESCO delegation will slow the work and retard the achievement of the worthy objectives of UNESCO.

"We are conscious of the possible exist- ence of a feeling on the part of many non-scientists that natural scientists are now, in the atomic age, suffering from a su- periority complex. We are not among those who believe that natural scientists have a perfect panacea for all the difficulties the world now finds itself in. We do be- lieve that natural scientists working in unison with other groups can assist in promoting scientific, economic, political, and social cooperation. It is a strange paradox that we are largely ignored at a time in history when we have so much to offer."

President Establishes Scientific Research Board

A Presidential order, dated October 17, instructs the Director of War Mobilization and Reconversion (Mr. Steelman) to:

"Review the current and proposed scientific research and development activities conducted or financed by all departments and independent establishments of the Government to ascertain (1) the fields of such research and development and the objectives sought; (2) the type and numbers of personnel required for the execution of such programs; (3) the extent to and manner in which such research and development is conducted for the Federal Government by non-Federal profit and non-profit institutions; (4) the cost of such activities.

"Review from readily available sources (1) the nature and scope of non-Federal scientific research and development activities; (2) the type and numbers of personnel required for such activities; (3) the facilities for training new scientists; and (4) the amounts of money expended for such research and development.

"Advise with the Director of the Bureau of the Budget in respect to such aspects of the foregoing matters as have a bearing upon the **Federal Budget.**

"On the basis of these studies and such other information as the Director may deem appropriate, prepare and submit a report to the President setting forth (1) his findings with respect to the Federal research programs and his recommendations for providing coordination and improved efficiency therein; and (2) his findings with respect to non-Federal research and development activities and training facilities, a statement of the interrelationship of Federal and non-Federal research and development, and his recommendations for planning, administering, and staffing Federal research programs to insure that the scientific personnel, training, and research facilities of the Nation are used most effectively in the national interest.

"To assist the Director in the performance of his duties hereunder, there is established an interdepartmental board to be known as the **President's Scientific Research Board,** which shall consist of the Director as chairman, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of the Interior, the Secretary of the Navy, the Secretary of War, the Federal Loan Administrator, the Federal Security Administrator, the Federal Works Administrator, the Director of the Office of Scientific Research and Development, the Chairman of the Federal Communications Commission, the Chairman of the Tennessee Valley Authority, and the Chairman of the National Advisory Committee for Aeronautics, each of whom may designate a full-time member of his staff as alternate to act in his stead. The Director may from time to time designate as members of the Board heads of other departments or independent establishments engaged in Federal research or development work. The function of the Board shall be to assist the Director in making the studies described in paragraph 1 and to advise and consult with him in the preparation of reports required by this order."

ARMY DIVISION OF RESEARCH AND DEVELOPMENT

Its Director, General Aurand, is responsible directly to the Chief of Staff and Secretary of War. C. H. Marvin, President of George Washington University, is Deputy Director. The Director is to be advised by a civilian advisory panel of 75 scientists. (See article by General Aurand in this issue.)

OFFICE OF NAVAL RESEARCH

This office, headed until November 1, by Admiral Bowen, and beginning November 1, by Commodore Paul F. Lee, has so far this year initiated 400 research projects, half of them by contracts with Universities and other independent research institutions.

Radiation Hazards and Radiation Sickness

. . . . *Dr. Hermann Li*

I

Recent discussions concerning the "Atomic Age" have ranged from National and International Control of Atomic Energy to the benefits that may be derived in the future from the use of radioactive tracers in research in physics, chemistry, biology and medicine.

There is one aspect of Atomic Energy that to the knowledge of the writer has not been discussed with the frankness that it requires.

Radiation sickness in its various manifestations has been known almost as long as X-rays have been available for therapy. It has been a problem of considerable practical and theoretical importance to relatively few people. Roentgenologists who treat patients with X-rays and physicians who are concerned with the care of patients who have been treated in this way are acutely aware of this disease. Indeed, the frequent occurrence of this condition in the course of treatment with X-rays often imposes limitations on the extent of such treatment.

Radiation sickness might be a problem of very considerable importance in the future, for the lives of many people have already been and those of many more people will be affected in the future in one way or another by the industrial development of the fission process.

II

Radiation sickness might come about in a number of ways, but we shall consider only two:

A. Radiation sickness caused by external irradiation in atomic warfare or by accidents or negligence in atomic energy laboratories.

B. Radiation sickness caused by internal irradiation, i.e., by the introduction into the body of radioactive materials by accident, or intentionally for therapeutic purposes, with subsequent irradiation of certain parts of the organism.

The term radiation sickness, like sea sickness, refers to a number of different manifestations of disease and although the term has been used in the past for the description of an illness that occurs in patients treated with X-rays it may properly include all manifestations of disease produced by ionizing radiation, ranging from acute signs such as nausea and vomiting to the delayed manifestations such as severe anemia and tumors.

An excellent and dramatic account of acute and subacute radiation sickness has recently been given by Hersey in his account of Hiroshima and it need hardly be elaborated further. With respect to the more delayed and chronic manifestations of radiation sickness one might point to the unfortunately large number of physicists and roentgenologists who—in the beginning due to ignorance and later due to negligence—have become victims of their profession by developing malignant tumors in chronic X-ray and radium burns of the skin. Another instance of delayed irradiation effect is the occurrence of severe anemia and of bone tumors in workers of the radium-dial painting industry. Here the development of fatal bone tumors has rather conclusively been demonstrated to occur in consequence of localization of radium salts in the bones and the continuous emission of alpha and gamma rays in living tissue. It might be added here that almost every manifestation of radiation sickness in man can be duplicated with ease in the experimental animal: from acute loss of white and red cells in the blood to the development, in imposing numbers, of bone tumors in animals injected with various radioactive isotopes.

III

Two intentional explosions of fissionable materials over Hiroshima and Nagasaki have killed tens of thousands of people and it has been estimated that about 5 per cent of the casualties have died as the result of irradiation. This percentage might yet increase by a certain number of delayed radiation deaths in the future. If so many people had not perished rapidly from blast or heat, the number of radiation deaths would undoubtedly have been much larger.

Two accidental chain reactions of plutonium have resulted in deaths of two scientists at the Los Alamos Laboratory in New Mexico during the last year.

Unfortunately it has proved to be impossible to materially alter the course of the eventually fatal disease in the case of the two scientists accidentally exposed to an instantaneous large dose of radiant energy at the Los Alamos Laboratories. The same might safely be assumed of the many people who died from irradiations in Japan. This would probably have been true even if adequate hospital facilities had existed at the time of the two explosions at Hiroshima and Nagasaki or if it had been possible to hospitalize such patients elsewhere immediately or soon after exposure.

Although certain unspecific and largely supportive therapeutic measures have been of some value in the past in treatment of radiation sickness, it the whole singularly disappointing t serve the lack of specific or effective apy. Present day information on the anism or mechanisms of action of ing radiations falls short by far of viding the physician with adequat formation for a rational and succe treatment of radiation sickness. Alth much is known of the acute and ch effects of radiant energy on human although a vast body of knowledge today with regard to the biological e of this energy on animals and plant method is available which would perm to look, if only with a slight amou confidence, into the future concernin management of patients who suffer acute or subacute radiation sickness.

IV

Like radiation sickness caused by e ternal irradiation that due to int irradiation is primarily a problem of vention. A number of deaths are k to have occurred within the last de following the administration of active materials. Some patients have shortly after the administration while ers died from tumors after a prol period of exposure.

Hazards in atomic energy plants manifold and they may roughly be di into the following categories:

1. Hazards arising from contamin of laboratory tools and equipment a air with radioactive chemicals and These may be present either in cons able amounts and thus the hazard i vious; or they may be present in a imperceptible quantities and yet be dangerous due to contamination of i body surfaces (skin, air passages, ali tary tract) and subsequent absorptio redistribution in various parts of the with the danger of rather perm localization in tissues such as the (as was, for instance, the case with ium in radium workers).

2. Hazards arising from injuries ceived while working under these c tions, i.e., contamination of wounds radioactive substances with an even g er danger of absorption, redistributio localization in the body.

3. Hazards arising from exposu personnel to various types and am of external radiation.

It has been pointed out repeatedly successful protection of the health of sonnel has been one of the outstan

plishments on the Atomic Energy t. Careful planning and constant oring have made the plants of the ttan District a safe place of work face of the most potent and poten- dangerous sources of energy. It is credit of those who have during st few years been concerned with otection of personnel in the Man- District that, so far as is known writer, no major emergency has as a result of contamination of uipment or of wounds with radio- substances. Industrial and preven- edicine probably has no parallel in ccess that has been achieved.

ty of personnel has depended in the nd continues to depend not only on gilance of the monitoring author- t to a considerable extent on the ce and cooperation of the scientists, s, on the realization on their part eir work belongs in the group of erous Trades" as they have been by Alice Hamilton. Consciousness dangers involved in the work has lly developed in the scientists of roject: it can and should be devel- urther.

of the first steps in the relaxation urity rules has been the announce- by the Manhattan Project of the bility of radioactive isotopes to civ- workers in scientific institutions hout the country. This most desir- nd welcome development poses new ons with regard to the protection lth of workers in these laboratories.

official Manhattan District form on requests for radio elements are submitted is cognizant of this dan- or it requires a description of in- entation available and of experience sonnel in radiation monitoring for protection.

rapid spread of radioactive mate- nto the Laboratories of the Nation g to pose a most serious problem of amination 5 or 10 years from now the most rigorous health and dis- rules govern the distribution of rad- e substances and unless the people ill be permitted to work with these nces have demonstrated that they oroughly familiar with the handling ioactive isotopes and that they are of the health hazards involved in ork.

as difficult and it took time to con- the scientists on the Manhattan t to exercise extreme caution and their work. Will it be possible to e—overnight so to say—a host of to be equally careful and patient in vork?

V

Another problem which becomes acute with the growing distribution of radioactive isotopes for research and therapy is the toxicity of certain radioactive substances that may be considered as potentially useful for therapeutic purposes.

It was pointed out earlier that radium salts are known to have been causally related to the occurrence of tumors in man. Animal experiments have shown that radium and other relatively long-lived radioactive isotopes have produced bone tumors in a significant number of experimental animals.

Radioactive phosphorus, iron and iodine are some of the substances known to have been administered to man in very small amounts. One wonders whether unpleasant surprises are not in store for us if therapy with radioactive isotopes is to be attempted on a large scale before the toxicity of these substances has been carefully investigated.

It might be proper to point out here, that it is erroneous to believe that radioactive substances have as yet benefited patients to an extent that would make this treatment one of the principal tools in the armamentarium of the physician. On the contrary, few therapeutic endeavors are as much in infancy as the therapy with radioactive substances. This is the case in spite of the fact that many of these substances were available for the study of biological phenomena and for treatment several years before the first pile was built. Recent events have only accelerated a development which was already well under way in 1942, and it will be some time before the therapy with radioactive materials will be as well established as is the therapy with sulfa drugs and penicillin, both of which have been developed and established in a much shorter period of time. As a matter of fact, one wonders sometimes whether therapy with radioactive substances will ever be a significant and indispensable tool in the hand of physicians as many appear to believe at present. It seems much more likely that our understanding of fundamental, normal and abnormal, biological processes will be considerably enhanced by the application of radioactive and other isotopes and that the better understanding gained in this way may lead to a more rational and perhaps non-radioactive treatment of disease.

VI

Many more examples could be cited in order to prove the importance of knowing much more than we do now about the toxicity of radioactive isotopes and about the mechanism, nature and pathogenesis of radiation sickness in all its aspects, whether it be due to external or internal irradiation.

Radiation sickness, although an artificial disease, might in importance take its place among spontaneous natural diseases. Like the latter it might also prove to be amenable to specific treatment in the future. It need hardly be stressed how important this may prove if atomic war is ever permitted to occur.

In spite of all our studies, it is a matter of record that we are at present in no way better prepared and equipped to deal with an emergency involving external radiation injury than we were prior to the inception of the Atomic Bomb Project.

In view of the rapidly expanding exploitation of nuclear fission for various purposes, clinical and laboratory investigation of all aspects of radiation sickness becomes a primary concern to those responsible for the welfare of the people connected with such developments and to all physicians interested in the welfare of the population as a whole.

BRITISH ATOMIC ENERGY BILL PASSED

The bill for domestic control of atomic energy in Great Britain, first read in the House of Commons on May 1, came up for second reading on October 8. After a general debate opened by Prime Minister Attlee, the Bill was considered in Committee on October 11, adopted without essential changes, given a third reading in the House and passed without division.

The main criticism of the Bill centered on Article 11, the security provision, which makes it a crime to reveal without the consent of the Minister of Supply, any document (or other material) describing existing or proposed plants, the purposes or methods of their operation, or any process used in them. Several Labor members advocated abolition of this provision. Another hotly debated point was the suggested addition of a new article providing for an Advisory Committee of scientists to advise the Minister of Supply (to whom the Bill gives full authority over atomic energy developments). The government sharply opposed this suggestion, which was then dropped.

We hope to present a digest of the Bill, and, space permitting, a report on the debates in the House of Commons, in the next issue of the Bulletin.

Atomic Energy and U.S. Patent Policy

Part 1: History of the Patent System . . . . Casper Oo

Commissioner Ooms has written two articles on patents for the BULLETIN: The first, printed below, deals with the general background of the U.S. patent policy; the second, which analyzes the patent provisions of the Atomic Energy Act will appear in our next issue.

The translation of the subject of atomic energy from the field of fundamental research and speculative fiction into the realizable promise of industrial applications has raised all of the questions that accompany a profound discovery in industrial techniques, besides the many political questions which have arisen because of the military applications of atomic energy. Necessarily the question of patents is among those which must be considered in any worthwhile plan for the most advantageous exploitation of this resource.

Any treatment of the subject of patents must begin with a consideration of the theories responsible for our patent system, the precise limits of control embraced by our patent laws, and the current practices with respect to the utilization of patents. With that foundation the peculiar problems raised by the subject of atomic energy may be considered.

Historically the patent system of all industrial countries arose from the desire to encourage the development of domestic industry. In our country the patent system has undergone extensive alterations since the practices of Colonial days. The statute now in force in the United States was enacted in 1870 and reenacted in 1874 as part of the United States Revised Statutes with numerous changes made from time to time.

DEFINITIONS OF PATENTABLE INVENTIONS

The several limitations which appear in this statute are worthy of note. In the first place, the American practice differs from that of Great Britain in that only the inventor himself can procure a patent; in other countries the owner who has acquired the invention by assignment from other inventors may file an application and procure a patent. In Great Britain and other countries the importer of an invention may procure a patent. In the United States only the first and original inventor may make the application.

The subject matter of patentable invention is quite limited by the statute, being confined to arts, machines, manufactures, compositions of matter, and designs. The statute has thus been limited from its very origin to exclude practically all fundamental scientific discoveries. The term "art" as it appears in the Act has been defined to be synonymous with the term "process". The term "machine" is clear and includes every mechanical device used to perform some function, thus embracing a structure that may be as simple as the lever or as complex as an automatic calculating machine. The term "manufacture" comprehends almost every type of article made by man. "Compositions of matter", which are separately prescribed by statute, may be defined as substances formed by the intermixture of ingredients or new chemical compounds.

In the project of producing fissionable materials in which the United States has been engaged these various inventions may have been encountered many times. The intricate procedures for the separation of fissionable materials were all processes defined in the statute by the term "art". The elaborate mechanical apparatus employed in handling and processing the materials are machines. Plutonium might doubtless be considered a "manufacture". Denatured plutonium, suggested in recent discussions of the control of fissionable materials presumably would be a manufacture or a "composition of matter".

Whether or not such contributions to the field of atomic energy are patentable depends upon another consideration and that is that the subject matter of the patent shall constitute an invention. The term "invention" has never been adequately defined in our patent law. It clearly excludes all obvious contributions. Courts have demanded that the intellectual quality of the contribution must be greater than mechanical skill or the routine ingenuity encountered among skilled practitioners in any field. This leaves the standard to be applied an exceedingly intangible and elusive test and necessarily results in frequent unsatisfactory determinations. The subjective character of the determination has the further unhappy effect of rendering uniformity in its application practically impossible, with the result that in a large organization such as the United States Patent Office with a great many of technically proficient men intrusted with the problem of determining the presence of invention in the respective applications which pass before them, great variations can be detected in the level of ingenuity being applied by the respective examiners. Similarly, when patents are brought before courts in litigation, widely varying determinations are inevitable. The statute itself gives no aid as the only prescription expressed there is the requirement the applicant for a patent be an inv

The statute does impose other limit upon the inventions presented for p ing. The invention must be new and u The test of utility is a simple one in all that is required is that the inve be capable of being put to some purpose. The law makes no distin as to the quality of uesfulness in but merely demands that the devi capable of some use other than a immoral or legally prohibited use. an atomic bomb, although capable o effecting destruction, is useful withi meaning of the patent law. On the hand, a machine or device, for exa which could be used only for gam might be held to be without legal u although this might be questioned much as gambling is not universally hibited.

The final requirement for any disc or invention to be patentable is that new. Under the United States Patent this means that the applicant for the ent must himself have made the inve and that there shall have been no pre knowledge of it. It is not sufficient m that the inventor independently mad invention and it was unknown to him others previously knew of the inve The statute previously quoted sets further that the subject matter of a ent application must not have been pa ed or described in any printed public here or abroad either before applic invention thereof or more than one prior to the filing of the application similarly, that the invention shall not been in public use or on sale in this co for more than one year prior to the the application is filed. Thus, the inv is required to move fairly promptly respect to the filing of a patent applic or his invention may be rendered unpa able by the publication of an article w he himself may have written descr the invention if that article is publi more than one year prior to the tim filing his patent application.

Because of the requirements of fo laws with respect to the effect of pub tion, it is dangerous for an America ventor to make any publication of hi vention before a patent application is in the United States Patent Office as effect of such publication may be des tive of the inventor's rights in the for country.

The United States Patent Law per the inventor to make some public us

nvention within the year which pre- the filing of his patent application ut loss of any rights. This is not true any foreign countries, and the pos-y of knowledge being acquired by s from any public disclosure of the tion renders it hazardous to foreign ting to make any public disclosure of iscovery prior to the time that the cation is filed in the United States.

e problem that frequently arises in dministration of the Patent Law is relating to the wholly independent tion of the same subject matter by ifferent inventors at substantially the time. The United States Patent Law not guarantee each inventor a patent, ffers the patent to the first inventor. foreign patent laws recognize only rst applicant. In the United States aborate interference procedure has established by which the question of ty of inventorship may be determin-asmuch as the process of making an tion may be extended in time, it is us that complex factual situations and present intricate legal questions e determination of the question of ty.

ENT PATENT PROCEDURES

Patent Act further prescribes the dure by which an applicant may pro- patent. He is required to file in the d States Patent Office a written ap-ion describing the invention and the er of its use fully and clearly so that son skilled in the art in which the ion appears may follow the teaching.

on receipt of the application by the d States Patent Office, the invention tified according to the subject matter ich it most nearly relates and is then nitted to one of the 65 Divisions the application is examined and a is made of the prior published art ermine whether or not the subject r of the application is novel. The t Office usually responds to the appli- with a written statement citing s earlier publications or patents most closely approximate the teach- the application and raise such other ons of form or law as require atten-The applicant is then given an oppor- to respond within six months or shorter period specifically prescribed. upon the applicant may amend the ation and make suitable argument in to the action of the Patent Office. rocedure is repeated until the appli- is passed to allowance or finally ed.

he Patent Office rejects the applica-he applicant is given an opportunity peal to the Examiners-in-Chief of atent Office and if their decision is sfactory, the applicant may either to the Court of Customs and Patent Appeals or file suit against the Commissioner of Patents in the United States District Court at Washington, D. C.

If the Patent Office grants a patent, the actual grant is issued under the seal of the Patent Office to the inventor, granting to him the term of 17 years from the date upon which the patent is issued "the exclusive right to make, use, and vend" the subject matter of the invention. This right is transferable by the patentee, and may be sold in its entirety or distributed among several persons by grant of separate territorial rights under the invention or the right to practice the invention may be licensed to others for limited periods of time and limited areas of the United States.

MISCONCEPTIONS CONCERNING PATENTS

A great deal of confusion exists in the popular conception of what the patent does. It does not confer on the inventor the right to use the invention as he had that at the time he made it. The patent merely gives the patentee the right to exclude others from making, using or selling the invention, a right enforceable only by suit in the United States Courts.

One of the popular misconceptions with respect to the rights conferred by a patent is the notion that a person may use any invention for his own personal purposes. This is not true. A manufacturer may not build a single machine covered by a patent and use it for his own purposes. This misconception probably arises from the fact that the Patent Law has been construed to exempt from the exclusionary power of the patentee the making or using of the invention merely as a bona fide experiment and without any intention to exploit it for profit. Inasmuch as this doctrine is particularly applicable to questions relating to the development and utilization of fissionable products, the limitations of the doctrine are difficult to define.

With this limitation it may be stated generally that any use of the patented invention within the United States or its Territories by one not authorized to make use of it by the inventor constitutes an infringement which may be enjoined by a court and may also result in a judgment against the infringer for damages.

Another general misconception with respect to patents is that the possession of a patent authorizes the patentee to use the invention disclosed therein. Inasmuch as a patent might be granted upon a broad invention such, for example, as a sewing machine, and a subsequent patent might be granted upon some detail thereof, such as a shuttle mechanism, it is clear that the second inventor could be given no rights with respect to the sewing machine itself, the rights thereto having been granted to the prior inventor of that subject matter. The effect of the coexistence of these two patents would be that the owner of the older or dominating patent could not use the particular improvement invented by the second inventor, and the second inventor could not lawfully use the broad invention patented by his predecessor. By appropriate licensing each could accord the other to use his own invention.

This cursory outline of the Patent Law discloses only the fundamental facts with respect to the patent system. In practice the observable effects of the operation of the system are that hundreds of thousands of people are being encouraged to make inventions and to submit applications for patents to the United States Patent Office. At the date of this writing more than 2,400,000 patents have been issued by the United States Patent Office and of these approximately 700,000 are alive and enforceable, the others having expired upon the termination of the life of 17 years.

Each of these patents contains an exposition of some invention, frequently accompanied by a drawing if the subject matter lends itself to pictorial illustration. Each patent terminates in one or more claims which precisely define the novel part of the disclosure which is claimed by the applicant and which constitutes the subject matter of the grant of the right to exclude.

Each patent thus forms a portion of the technical literature of the art in which it appears and furnishes a teaching which may be universally used upon expiration of the patent and which, meanwhile, may form the basis of experimental work in the same direction or in some alternative direction which can be followed without any invasion of the patent right.

The right to exclude others from the use of the invention not only forms a valuable property which frequently constitutes the incentive leading to production of the invention, but may enable the possessor to enter into the exploitation of the invention with some assurance that he will have exclusive possession of the field for a period sufficiently long to enable him to recoup his investment in research, development, and initial manufacture, and may also enable him to initiate a business against the greater advantages which well-established and larger competitors may possess.

The patent has one other effect in that its possession by one manufacturer compels other manufacturers who would compete in the same field to avoid the patent and make other inventions and thus diversify the gross product of the industry. This compulsion to diversification is no small factor in the contribution which the patent system makes to the country.

Letters to the Editor . . . . . .

Wallace vs. Baruch

With the following two communications, we initiate this section of the Bulletin which we shall devote to criticisms of articles or editorials in the Bulletin. We shall also print significant comments which are two brief for publication as articles. (Though we have appreciated and shall continue to appreciate the letters of commendation we receive, we do not believe them to be as informative to our readers.)

If the organized atomic scientists continue to follow Mr. Baruch's lead in the uncritical spirit lately manifested, it is my belief that their hitherto promising efforts to prevent an atomic armament race will come to nought. The potential contribution of the scientists lies in applying their training in objective observation and thinking to the problems of politics. That is what they started out to do, but only traces of the original attitude can be discerned in the editorial and other comments on the Wallace-Baruch controversy in the October **Bulletin.** If the scientists are to become merely another arm of nationalistic self-righteousness, their political efforts can well be spared.

The scientists on Mr. Baruch's staff are of course obliged to go along publicly with everything he says and does. The rest of us are not. We don't have to accept Mr. Baruch's policies in packaged form. In my view Mr. Baruch is right in his insistence on international control of atomic energy at the source, and on punishment of violators by an international agency. The Russians have no case in their opposition to these two items in the American proposal. But Mr. Baruch is equally wrong in his patriarchal intolerance of criticism, his hostile reaction to Mr. Wallace's temperate comments in the July 23 letter to the President, and, vis à vis both Wallace and the Russians, in his rigidly legalistic and coercive approach to the whole problem of control.

The wording of your comments on Mr. Baruch's memorandum implies that there was something blameworthy in Mr. Wallace's refusal to sign the memorandum drawn up by his representative, Mr. Hauser, and Mr. Swope, acting for Mr. Baruch. Why do you think so? You will recollect that Mr. Wallace had several other weighty matters on his mind when Mr. Baruch summoned him before the bar of judgment. In the oral give and take between Mr. Baruch and Mr. Wallace, either or both men may have said things which were not truly and completely expressive of their views. The two delegates were appointed to draft a definitive statement. It seems to me that Mr. Wallace was not only within his rights in declining to subscribe to the resulting document if it did not embody exactly what he felt, but that he would have been exceedingly remiss had he failed to exercise his prerogative. To yield in a dispute involving only individual interests is one thing, to give way under pressure on a momentous public issue is quite another. As far as I am concerned, Mr. Baruch's handling of the matter is just one more indication of an intransigeant attitude which is one of the road-blocks in the way of an agreement with the Russians. It may be remarked that his great achievements in the country's service were the result of a very different attitude and approach.

More important, however, this intransigence is embodied in the provisions of the American proposal. Coupled with American naval and air maneuvers, it constitutes a hard-boiled diplomatic offensive wrapped up in the usual pious phrases. We offer to turn over to an international authority our atomic knowhow and to forego the manufacture and accumulation of atomic bombs at an indefinite time in the future when, in **our** judgment, there no longer remains any danger of the fabrication and use of the bomb by others. In the interim, as a sine qua non of American participation, no other nation will be permitted to develop atomic weapons of its own. In effect all the nations of the world will be on probation, reporting to the United States as the probation officer, until we choose to release them.

How can I say this? Because Mr. Baruch says it—naturally not in such forthright terms. In his latest speech on the subject (at Freedom House on October 9) he quoted from his original declaration: "My country is ready to make its **full** contribution toward the end we seek, **subject, of course, to our constitutional processes** and to an **adequate** system of control becoming **fully** effective, as we finally work it out." I have italicized the qualifying terms to show that, in spite of the added note that "we" refers to all the participating nations, final discretion is retained firmly in American hands. We stand pat on our exclusive possession of the weapon.

This interpretation has been confirmed. In answer to a newspaper reporter's question, Mr. John Hancock explained on Mr. Baruch's behalf **(PM, Oct. 10, 1946)** that while the stages and timing wo[...] agreed upon beforehand, he cou[...] even hazard a guess as to when th[...] would become "fully effective." Mr [...]cock added that this would certain[...] be until we were assured that no [...] nation could illegally manufacture [...] bombs.

During this indefinitely long peri[...] fore the plan becomes "fully effe[...] the atomic bomb remains poised [...] Russian heads. Under these conditi[...] may expect the Russians to rem[...] recalcitrant as they dare and perh[...] conclude that their best chance is [...] to catch up on their own techno[...] initiative. They can hardly be ex[...] to share the inverted logic exemplif[...] the remark of Mr. W. Stuart Symi[...] our Assistant Secretary of War fo[...] who, after the flight of a B-29 ov[...] North Pole to Cairo, emphasize[...] danger **to the United States** of an [...] over the polar regions.

The trouble with our plan is t[...] seeks to prevent an atomic armamen[...] by tying every other competitor [...] starting post, while we forge still f[...] ahead by continuing to manufactu[...] bombs. Whatever sacrifice of sover[...] is involved on our part is purely a [...] sacrifice, since as long as we posse[...] bases, the carriers, and the bomb[...] no other nation commands all thr[...] can reinstate our sovereign right to [...] atomic war whenever we choose. T[...] Russians this may seem a less r[...] threat than it does to us. They can [...] be expected to show our equanim[...] the face of the shrill cries for a p[...]tive war, the press campaign carri[...] unremittingly since the end of th[...] war, the demand to stop appeasing [...] and to get still tougher, and all the [...] manifestations of American bellig[...] beating in great waves against the [...] policy of moderation. They do not [...] how long the wall will stand—nor [...] who support it.

If there were no safe alternati[...] Mr. Baruch's plan he and his colle[...] would not be open to criticism. But [...] is an alternative. Mr. Wallace ha[...] lined it in general terms. I should l[...] offer a specific suggestion which in[...]

naterial risk on our part and which t lead us out of the existing impasse. United States could make a formal aration that it will forego the use of ic weapons for a specified period, ing agreement on a covenant binding ations not to manufacture weapons nass destruction in this or broader gories, this agreement to include the ction and other provisions of the ex- American proposal. But more than s are needed. The declaration should ccompanied by a commitment to de- , or to turn over to the military of the UN Security Council, the bomb anisms already produced, and to dis- nue manufacture of bomb parts and nblies. Only these— the manufacture sionable materials would continue.

is would admittedly amount to little than a demonstration of good will. irm agreement had not been reached e expiration date, we should be freed our commitment and the situation l revert to its present status. The ary sacrifice on our part would be . Nevertheless, such a gesture, made terally and without the usual de- for a quid pro quo, might improve nternational atmosphere and encour- a more conciliatory attitude on the of the Russian negotiators. Cer- it is something we have not tried. without the atomic bomb, the United s were in a militarily inferior posi- if, however, we were in danger of nt attack, this proposal would be acticable. We could not spare, even a limited period, the one weapon h stood between us and possible de- But we find ourselves in no such ion. The United States, without the c bomb, is far superior to Russia in trial capacity and in every military h except ground forces. The Rus- have no navy worth mentioning, no range bomber fleets. They will have range guided missiles sooner or later, ve should experience no difficulty in taining parity with them in this field, tter. They certainly cannot produce c bombs in quantity for several . We, on the contrary, already have gh bombs on hand to wipe out the Russian industrial centers overnight. decline to take the step advocated, l not be for reasons of security, but se it is inconsistent with the hard- diplomatic technique which we are icing.

is not encouraging, but neither is it surprising, that the one man with the courage to raise his voice against that technique and its somber implications has been forced out of the Cabinet amid the ululations of the press. It is somewhat surprising that the atomic scientists, in their quieter tone, have joined the forces arrayed against Mr. Wallace. I do not know if this represents the consensus of scientific opinion. I hope not. Unless the scientists are capable of a patriotism no less fervent than Mr. Baruch's, but more modern and enlightened, the general outlook becomes even a little darker. The effect on scientists as a social group can also be forecast. They will be relegated once more to the position scientists and engineers have traditionally occupied. They will be makers of tools, and tools themselves—no more than that. If war is happily averted, it will be none of their doing.

Carl Dreher

Military Support of Research vs. National Science Legislation

As a consequence of the remarkable wartime technological developments which resulted from the application of basic scientific knowledge acquired by peacetime research, many groups who are concerned primarily with the applications of science to practical ends have come to recognize the value of truly fundamental research. The Army and Navy are outstanding examples, and it is highly commendable that, recognizing the value of fundamental research, they have assigned extensive funds to universities, under liberal contracts which permit research relatively free of restrictions. But the fact that scientists must depend on the Army and Navy for their funds may ultimately defeat the purpose for which these funds are provided. In raising this criticism it should be made clear that it is not the Army and Navy who are at fault: they have acted most intelligently in recognizing the need for a more adequate support of basic research; this criticism is directed at the American Congress for its delay in passing the bill establishing a National Science Foundation.

The reason for the undesirability of military sponsoring of research lies in the nature of fundamental research and in the atmosphere necessary for its pursuit. Fundamental research consists of the discovery and elucidation of natural phenomena and the subsequent formulation of the basic laws of nature. Very often such discoveries and laws have no immediate practical applications, serving only as a contribution to the general framework of theory which is a fundamental part of science. History teaches us that these researches have often the greatest significance in the light of later discoveries. A striking example is the development of the practical utilization of atomic energy, which depended on chemical and physical knowledge dating back many years in scientific history, extended by individual investigators in many lands.

For this kind of research a certain atmosphere is required. The scientist must be free to exercise the full range of his curiosity and imagination, without having to justify his experiments for the practical minded, or to seek practical application of his theories, or to write monthly reports. For its most fruitful fulfillment, fundamental research must be completely divorced from concern with practical matters of this sort. Grants for fundamental research should be made at the discretion of a civilian board made up of scientists qualified to judge the value of a research project, and above all the researcher. Such a decision should not reside in a military or political officer, nor should a scientist be accountable for his work to a military or political officer.

Only under conditions of completely free fundamental research will the best possible development of science continue. It is fortunate that funds have become available for the more extensive support of university research; the need for such funds is great. But it should be recognized that Army and Navy sponsoring of research is only a stop-gap arrangement, serving until the time that a National Science Foundation is established by the Federal Government. We therefore urge the speedy enactment of a bill establishing a National Science Foundation.

Otto Stern

BULLETIN of the
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Cambridge Conference of Natural And Social Scientists

A conference was arranged by the Association of Cam Scientists to explore the possibilities for cooperative re and action by social and physical scientists in the field of energy. The main objective of the conference was to ex the problems raised by atomic energy in order to determi areas requiring further study, research and discussion; th ference made no attempt to arrive at definite conclusio garding these subjects.

On Sunday afternoon, October 27, the conference vo set up a Continuing Committee, charged with the respons of considering ways and means of implementing the r mendations, made by the various panel groups and by th ference as a whole, for study and action. This committe sists of: Prof. Merle Fainsod—Chairman, Government Harvard University; Prof. Seymour E. Harris—Dept. o nomics, Harvard University; Prof. Donald C. McKay— man, Committee on International and Regional Studies, H University; Prof. Talcott Parsons—Chairman, Dept. of Relations, Harvard University; Prof. Karl Deutsch—De History, M.I.T.; Prof. Bernard T. Feld—Dept. of Ph M.I.T.; Prof. Herman Feshbach—Dept. of Physics, M Prof. Ronald Lippitt—Research Center for Group Dyn M.I.T.; and Prof. Victor F. Weisskopf—Dept. of Physics,

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LETIN of the ATOMIC SCIENTISTS . . .

. 2 DECEMBER 1, 1946 Nos. 11 and 12

litorial:

eedom of Scientific Publication . . . .

efore the war, the results of scientific research were pub-d as promptly as it was technically possible. Scientific nals vied in providing facilities for rapid publication of the t discoveries. Open and rapid publication permitted "cross-lization" of research in different laboratories, minimized otherwise inevitable duplication of effort and fostered a ng of community of research workers all over the world. riction of publication was practiced in industrial research, this did not affect the progress of science, particularly large concerns learned to rely on continuous leadership esearch and development rather than on "secret processes."

n the Soviet Union, too, the freedom of scientific publication on the whole, unimpeded; because of the absence of indus- competition, technological research was published even freely than in America. Only occasionally, did the Soviet rnment decide that a certain field of research was of cular importance for national security and placed it under cy restrictions.

What was once a minor exception became a general rule all the world during the war. Nuclear physics, bacteriology, ronics, became closed preserves which only scientists with opriate badges were permitted to enter.

DECLASSIFICATION PROBLEM

year has passed since the Truman-Attlee-King declaration aimed the intention to return to the free publication of the ts of fundamental research. Only the release of information echnological procedures was to await the establishment of antees against misuse of atomic energy for destructive oses.

a pursuance of this policy, the Manhattan District appointed classification Committee (declassification being the technical for the removal of the designation "secret" from official ments). The report of this committee was approved by ral Groves and an organization was set up to handle the ssification procedure. (This organization was described in el Hutchinson's article in the November 1 issue of the tin.) A list of publications thus far released is reprinted here in this issue.

rofessor Weisskopf points out, in a letter also published is issue, that the scientists in Europe are growing pessi- c about ever receiving any information on the real progress ience in America during the war. The facts given above that these apprehensions are somewhat extreme, and that in steps towards the restoration of a free flow of scientific mation are being made. However, in order to be able to hat the Tolman Committee declassification plan has actually implemented, not only must the present dribble of largely ental and often unimportant releases be replaced by a of paper covering the most important scientific progress during the war, but information on declassification papers be disseminated and the papers themselves made available who need them.

he McMahon Bill has instructed the Atomic Energy Com- on to be guided by the principle that the "dissemination of scientific information relatng to atomic energy should be encouraged to provide free interchange of ideas which is essen- tial to scientific progress." This dissemination is needed not only to restore the international co-operation in science and to "appease" the foreign scientists, but to permit American science to resume its progress on a broad front, and to prevent con- fusion and duplication of effort bred by war-time compartment- alization and discrimantion between scientists with and without badges.

WHERE TO DRAW THE LINE?

Beyond the immediate task of publication of what has already been declared publishable, the criteria by which the science is being divided into "open" and "secret" fields need fundamental re-examination. In the Truman-Attlee-King declaration, the distinction was made between "fundamental research" and "tech- nological know-how." Similar language was retained in the McMahon Bill. The British Atomic Energy Bill, reported in this issue, substitutes another definition. It defines as restricted, information "pertaining to an existing or proposed atomic energy plant, and important for national security." In practice, the American declassification rules also involve what General Groves has referred to as a "jig-saw cut" through the body of scientific information, leaving on the "secret" side things "important for national security." The article of Colonel Hutchinson implied that this fine surgical operation is being performed with com- plete success.

Now it has been said that the boundary between fundamental research and technological know-how is artificial and indistinct; but certainly it is much more real that the line between scien- tific information "important" and "unimportant" for national security. There is no use deceiving the public and Cngress that we are having our cake and eating it—adhering to the policy of freedom of science but not giving away anything which

(Continued on last page)

IN THIS ISSUE

Science, Government and Industry in Britain

. . . . *Sir Edward V. Apple*

I have chosen as the subject "Science, Government and Industry" because I believe that the proper direction of scientific effort and the proper application of the results of such effort is one of the most important challenges of our time. Stimulated by the realization of the magnificent services rendered by scientists in support of the Allied forces during the war, science and its consequences have become a matter of interest to the ordinary citizen. It is no new thing to the thoughtful mind that science has practical and social consequences. What is new is that the general public is now sharply aware of them. As a prominent newspaper man recently expressed it to me "Science is news, as never before."

Now I think it can be said that this awakening to the importance of scientific work on the part of the public has been due in large measure to the fact that, during war, events move fast, and the four stages of research, development, production and use follow so rapidly on the heels of one another that the practical consequence of scientific effort is clear for all to see. The public has naturally concluded that if science can solve so many of the problems of war-time, it should play a similar role in solving the problems of peace. The problems that confront us now are, in an ultimate analysis, the provision of work, homes, food, health and safety—safety from aggression—for all; and these problems depend for their solution on the maintenance, in some degree, of the same kind of partnership between Government, Science and Industry which grew up during the war.

Now one of the most striking results of our war-time experience has been the brilliant success of our University research workers in solving war problems entirely remote from their peace-time interests. Various reasons have been advanced for their success. It has been pointed out that they had fresh minds. It has also been stated that, in approaching a difficult task, "They didn't know it couldn't be done." It has further been claimed that they had a better background of fundamental principles than the majority of those with whom they worked. I do not profess to be able to assign the result to any one of these causes. But what cannot be doubted is that University conditions certainly do, somehow, generally insure the maintenance of mental adventurousness and lively imagination so necessary for scientific progress; and we, in Britain, believe that in planning the future of our Scientific Civil Service we must try to ensure that conditions are encouraged that will bring these same things about.

Another deduction I make from our war-time experience is that the most successful applications of science have resulted from the closest possible collaboration between the scientist and the military staff. The great naval writer Rear-Admiral A. T. Mahan once drew attention to the long period which used to elapse between changes of weapons and the consequent changes of tactics. He attributed this lag to "the inertia of a conservative class." Fortunately we can be satisfied that in the war that has just ended such gaps have not been unduly long. This has been due not only to the close collaboration between scientist and service man but also to the fact that in many cases scientists have assisted their service colleagues in working out plans for the use of new weapons. Indeed it has been realized that the field in which the scientist can usefully operate extends far beyond that of the laboratory.

My third comment on our war-time experience relates to subject matter. We have seen a mighty effort resulting in outstanding developments in weapons and instruments, culminating in the atomic bomb. By no means all this effort has been wasted, even if judged solely by its peace-time scientific interest and importance. But in this intensive drive many inviting scientific avenues have had to be just noticed and passed by. When fundamental work has had to be done, as in the case of nuclear physics or in radio wave propagation, it has necessarily had to be objective in character and relevant to the major target. What I may call free fundamental work—free in the sense that its selection is dictated solely by man's curiosity—has been almost wholly in abeyance. We cannot recognize the return of peace in any better way than by changing all that. Our priorities must be revised. We have in many fields been living on our scientific capital which now stands urgently in need of replenishment. For this purpose the British Government has set its own priorities, for the time being, as regards the release of scientific staff from Government service in the following order:

(1) Universities and fundamental research.
(2) Civil Science, Government and Industrial.
(3) Defense Science.

You will see in this a complete reversal of the priorities which obtained in wartime.

CIVIL SCIENCE

In turning now to the future w[...] that, as in most countries, scienti[...] search in Britain is, in the main, [...] out by three types of organizations [...] differ somewhat in motives and obje[...] These three organizations are:

(a) **Universities and like instit**[...] carrying out what I shall call free [...] mental research. This is carried o[...] the purpose of extending the [...] frontiers of knowledge if I may u[...] graphic expression of Dr. Vannevar [...] This type of research, the result of [...] lectual curiosity and the love of [...] for its own sake, is carried out w[...] regard to any immediate or futur[...] ful application.

(b) **Government establishments** [...] ing out what I may call objective [...] mental research and also applied res[...] By objective fundamental research I [...] research designed to give insigh[...] understanding rather than any speci[...] mediate practical result. It is call[...] jective because it is relevant to som[...] of practical importance and

(c) **Industrial Research Labora**[...] carrying out mainly applied researc[...] also, in enlightened firms, a c[...] amount of objective fundamental res[...]

But I do want to emphasize her[...] there is no sharp differentiation be[...] my divisions into (a) free fundam[...] (b) objective fundamental, and (c[...] plied, research. However, I do find [...] a more convenient classification tha[...] older division into "pure" and "ap[...] research which always had, to my [...] the suggestion of snobbishness ab[...] A certain mathematician once [...] that "Bessel functions are beautiful [...] tions in spite of their many applicat[...] and I well remember hearing a [...] scientist boast that he could claim [...] what he had done could never b[...] slightest use to anybody. It turne[...] to be an idle boast, as we might hav[...] pected. His work has become o[...] greatest practical importance.

(1) UNIVERSITY SCIENCE

It is a remarkable fact that Univ[...] scientific research is of relatively m[...] growth. Scientific research, as we [...] it today, began in the seventeenth ce[...] when the experimental method rep[...] the method of ex-cathedra stateme[...] argument by which, since the M[...] Ages, man had endeavored to find [...] The scientific method of inquirin[...] observation, theory and experimen[...] often been attributed to Francis B[...] though my own view is that of Dr. W[...] Gilbert, the physician of Queen Eliz[...]

The above is an address delivered on Nov. 19th as the inaugural lecture under the Arthur Dehon Little Memorial Lectureship at Massachusetts Institute of Technology.

Fellow of my own College, St. John's ambridge, has a stronger claim to be ed its author. But the teaching of experimental method did not form of the University curriculum in the teenth and eighteenth centuries, and atories did not form part of University equipment. Early in the nineteenth ry, however, teaching laboratories cience were instituted and research ne a spare time activity of professors lecturers. From small beginnings has developed till it is now an acd part of University tradition that ers of scientific knowledge should advance that knowledge. It is moreimportant to note that though carried n a spirit of pure inquiry this free mental research has shown a surg capacity for being useful.

en we also look to our Universities only to make science but to train rs of science. We look to them for supply of trained scientific workers will later occupy positions in Unity, Government and Industrial Labries. We find that this training in rch is best accomplished by a senior rch worker acting as supervisor to up of research students which should e large.

must never forget the outstanding rtance of the exceptional man in this ct. Most of the really great ads in science have been accomplished mall teams of workers of this kind a man with ideas. As one concerned, me extent, with the organization and rt of science in Britain, I believe a vital task is to see that these rs, these men with ideas and inspira- lack neither disciples, assistants or ment. When such needs have been ied they should be left alone.

GOVERNMENT SCIENCE

ow turn to Government Research of n, even apart from Defense Research, rnment in Great Britain conducts a deal that perhaps you would regard eing primarily the responsibility of stry or other bodies. Here we defi- enter the utilitarian field.

ough their object was in the main atisfaction of their disinterested intual curiosity, the natural philoss of the seventeenth century easily nized that the results of their riments could lead to important apions. Not only did they appreciate mportance of what Bacon called *rimenta lucifera* — experiments of which illuminate our knowledge e nature of things, but they also eciated what he called **experimenta ifera**, experiments of fruit, which ed knowledge which could be applied, acon pointed out, to extend the empire an and to ameliorate the condition of which he regarded as wretched. In his "New Atlantis" Bacon described what he calls Salomons House, a kind of national research laboratory which had the object of arriving at "the knowledge of causes, the secret motions of things, and the enlarging of the bounds of human empire, to the effecting of all things possible." You will be interested to note that of the staff for this national laboratory he writes "We have three that try new experiments such as themselves think good. These we call Pioneers. We have three that bend themselves, looking into the experiments of their fellows and cast about how to draw out of them things of use and practice for man's life and knowledge. These we call Benefactors. Lastly we have three that raise the former discoveries by experiments into greater observations, axioms and aphorisms. These we call Interpreters."

Somewhat later, the scholarly Boyle, too, discoursed largely on the "Usefulness of the Experimental Natural Philosophy" pointing out the usefulness of mechanical disciplines to natural philosophy and how the goods of mankind may be increased by the naturalist's insight into Trades, and of doing by physical knowledge what is wont to require manual skill.

The close of the eighteenth century brought from America to Great Britain and Europe that singularly gifted Secretary, General and Statesman, Benjamin Thomson Count Rumford who, while making several purely scientific discoveries of the highest importance, found practically the whole of the inspiration of his scientific work in his desire to use science to improve the living conditions of the common people. He was, I think, the first, conscientiously and deliberately, to utilize science as a means of increasing the health, happiness and comfort of his fellow man.

Very little was heard in the nineteenth century of the possibly useful applications of science which was still studied in the main for its pure intellectual interest. I recently, however, came across a most interesting article written in the Fortnightly Review in 1873 in which the author, Dr. George Gore, F.R.S., points out that scientific research is the only source of the new knowledge which is indispensable to national progress. As he says "Without new knowledge the thoughts of men run in circles and intellectual and material progress ceases."

After calling attention to the, what he calls, deplorable lack of support given to fundamental scientific research, he proposed that there should be formed state laboratories for original research.

Very little notice seems to have been paid to these advocates of State assistance in the prosecution of research for the national benefit in Great Britain until, in 1900, the National Physical Laboratory was founded with Government assistance.

It was set up largely as a result of the efforts of the late Lord Rayleigh who, in Britain, realized earlier than most how the progress of modern industry depended to an ever increasing extent on accurate measurements and precise knowledge of the properties of materials.

It required the impact of the first World War, however, seriously to awaken the British Government to the necessity for State action in regard to scientific research and, as a result, in 1915 the Department of Scientific and Industrial Research was established as a separate Department of State, under the Lord President of the Council who is advised by an Advisory Council. The Department of Scientific and Industrial Research is not, of course, concerned with the whole field of science. Agricultural Research and Medical Research are dealt with by sister organizations, also under the Lord President. There are, naturally, scientific experts in the Ministries responsible for defense, trade, food, health, fuel, transport and so on, so that, very wisely I think, there has been no attempt to confine scientific knowledge to one Ministry alone since it has to be applied by many.

The major part of Government civil research in the sphere of physical, chemical and industrial interest is, however, centered in a group of ten research organizations under the Department of Scientific and Industrial Research (D.S.I.R.) through which we try to provide a central scientific service for the executive departments of government and also to carry out research on matters of common interest to industry and to the community as a whole. That is the first function of the Department. Our second is the encouragement of research by industry itself, and more directly by fostering the formation of co-operative research associations, of which I shall have more to say later. Thirdly we assist, by means of grants, free fundamental research of timeliness and promise in Universities in Great Britain, and we endeavor to provide an adequate supply of trained research workers by means of maintenance allowances.

But before I mention further details of the Department's activities I would like to draw your attention, too, to the special position allotted by our founders to the Advisory Council which advises the Lord President on all the Department's research activities and expenditure. At present this expenditure is running at the rate of three million pounds per year. The Advisory Council is composed of men who have an expert knowledge of science or of industry and who serve in their purely personal capacity and not as representatives of any particular organizations to

which they belong. It was, when first formed, one of the first bodies composed of men outside Government to advise on policy for implementation inside Government. Individual members of the Advisory Council retire after five years' service.

In addition to the Advisory Council we have a Research Board or Committee to advise on the work on each of our research organizations. Each Board or Committee is, again, composed of independent members who are chosen by the Lord President for their special knowledge and experience. Thus, by way of our various advisory bodies, our university and industrial scientists and our industrial leaders exercise a direct influence on the activities of the Department.

I now turn to say a word or two about our own ten Research establishments. The full list of the Department's stations is as follows: National Physical Laboratory, Building Research Station, Chemical Research Laboratory, Food Investigation Organization (dealing with the storage and preservation of food), Forest Products Research Laboratory, Fuel Research Station, Geological Survey, Pest Infestation of Stored Products, Road Research Laboratory and Water Pollution Research Laboratory. Earlier in my talk to you this evening I referred to Count Rumford, who was born at Woburn, Massachusetts, as probably the first to apply the methods of science to problems connected with the primary domestic needs of mankind. It is singular coincidence, but many of the problems he investigated are precisely those for which we have thought it desirable to set up special laboratories. For example, his work on the economy of fuel, on the design of kitchen stoves and on the reduction of smoke from chimneys is paralleled by that of our Building Research Station on fuel economy, domestic heating appliances, and atmosphere pollution. His work on ventilation and the comfort conditions in rooms is similarly paralleled by that of our Building Research Station on the same subject. Similarly his work on the tractive force required to draw carriages having wheels of various widths over roads of different types has connections with that of our Road Research Laboratory. Rumford also carried out research on food, paying attention to its nutritional value, its economy and its efficient preparation; we also have a Food Research Organization. Finally, though there may be other comparisons which have escaped me, he invented his celebrated photometer and carried out researches on the lighting of rooms and the design of lighting fittings, activities which are continued today at the National Physical Laboratory.

I do not propose to weary you with a description of the work of all our stations. I shall select only one station as an example for brief comment, namely the Fuel Research Station.

A most important section of work of the present time is that of the National Coal Survey, which is conducted at nine laboratories of the various coal fields, with its headquarters at the Fuel Research Station. The purpose of the Survey is to determine the physical and chemical properties of our coals both as they occur in seams in the ground and as prepared for the market. On the basis of the data collected it is possible to indicate the most suitable uses of the different coals and to predict with considerable accuracy the probable properties of coal in seams that are as yet unworked.

The Coal Survey, in conjunction with the Geological Survey collaborates with the Coal Commission and the Ministry of Fuel and Power in assessing our national reserves of coal, which since 1942 have belonged to the nation. It will be seen that the data collected by the survey are essential in the planning of future mining operations if we are to use our not unlimited resources to the best advantage.

Now in considering the applications of science we must note the changing function of Government. In Graham Wallas's famous phrase it "has come to be engaged not merely in preventing wrong things from being done, but in bringing it about that the right things shall be done". In discharging this most positive function we find that, to an increasing extent, science is being used as part basis for the formulation of Government policy. A very interesting problem of organization therefore arises. We desire scientific knowledge to permeate the executive departments. How far, then, can a central scientific department serve these executive Departments, and in what way should its service be supplemented by scientific staff and scientific work within the executive Departments themselves? I do not pretend to be able to give, in answer to these questions, a simple formula which would be applicable to all cases. But quite extreme views have been expressed in Britain on this subject. It has been argued by some that all science should be made in a central scientific Department and none in the executive Departments. It has been correspondingly argued by others that each executive Department should have sufficient scientific staff to make all the science which it needs in the discharge of its own responsibilities. The latter answer seems to me to overlook the need for economy of scientific effort. Because the police need wireless, as do so many other civilian and military services, there seems no case for the Home Office to set up its own radio research unit if it can be equally well served by a c- radio research organization. Corres- ingly, there is no need for the Minis Health, which is responsible for ou water supply, and the Ministry of and Power, which is responsible fo mining development, both having own Geological Survey units. So I argue that there are weighty eco reasons for the use of some, even all, common scientific services.

But, granted that there are some c scientific services, how can we insur their work can be effective in the exe departments?

One solution of this difficulty i appointment of a Scientific Advis each executive Department, who ca

(a) identify the problems withi Department which are suitable for tific treatment;

(b) see that these problems are p to the appropriate research bodies a solve them; and

(c) interpret the incoming scie material for the special purpose o Department. But I should stress tha such a scientific advisor to be effect is necessary that he should be suffic senior in the Department hierarchy. advice should be tendered to the hi level—the level at which policy is de

I have so far stressed the value o work of D.S.I.R. to Government through Government, to the commu But there is also another link wit community, and that is through indu In this connection the Department s industry chiefly by conducting res on generic fundamental problems o basis of which industry itself can applications. The greater part of research is what I called objective f mental research. In this case the quest is understanding. Here the sci seeks physical or chemical insight, even atomic insight, into certain fiel practical importance. This may rela the corrosion of metals, the oxidati fats, the toughness of meat, the wa of wood, the electronic changes in ionosphere and so on. Armed with u standing, many practical problems relatively easily solved. Very oft basic attack of this kind is the most ful and shortest route to the soluti a problem of practical importance. very often quite unexpected and unsc applications are thrown up as by-pro of such fundamental research.

(3) INDUSTRIAL RESEARCH

I now turn to the subject of indus research which is conducted in Britai private firms and by the industria search associations. The larger firm an increasing extent, have their own oratories, some of which are compa in size and scope to the larger Govern research laboratories. But these lab

ries exist mainly in the newer in-ries which were, in any case, born and l on science and to whom scientific earch is the life blood. In many cases n firms carry out not only applied re-rch, but also objective fundamental re-rch relevant to their own interests. y are, of course, at liberty to keep the lts of their scientific work to them-es, but in general they follow an en-tened policy and their staffs are ortant contributors to the world's ntific literature.

Vith a view to stimulating research by ate firms the British Government has ntly introduced certain fiscal changes. many years now it has been possible a "trader" to count current revenue enditure on scientific research under-n in relation to his trade as a deduc- in computing profits for income tax poses. But as from 6th April of this r provision has been made whereby tal, as distinct from current, expendi-, is allowable for income tax purposes ve equal annual installments. For this pose capital expenditure may relate, to the building of research laborato- or the installation of pilot-plants.

ut in considering industrial research Great Britain, we are at once faced the fact that over 98 per cent of our s employ less than a hundred work- so that although it is admitted that arch always pays a dividend if you enough of it, to a small firm without iderable financial reserves industrial arch on its own account must often ear as a risky adventure and beyond neans. This difficulty has been met to onsiderable extent by the D.S.I.R. h, as I mentioned earlier, is charged the duty of encouraging research in stry.

he main method by which we have this is by the formation of Research ociations each on a co-operative basis erve the needs of particular industries. e Research Associations are self-gov-ng bodies formed on a national basis, nced mainly by the contributions of member firms but supported by sub-tial grants from the D.S.I.R., the of which is related to the amounts ed by the industries.

here are now thirty-five or more of e Research Associations and their ex-liture on research is nearing one and alf million pounds per year, having from a little over a quarter of a on in 1934 to a half a million just re the war. I should not be at all sur-ed myself to see this figure more than led in the next few years. In the past months it has heardly been possible ep pace with the new research associa-, so quickly are they being formed.

or a very modest contribution, less the cost of a single junior research worker, a small firm is enabled by joining a Research Association to share in research costing thousands of pounds, and in some cases hundreds of thousands a year. The Research Associations also keep their members informed on scientific and technical developments throughout the world, provide them with advice on their day-to-day problems, and insure that the industry as a whole has an opportunity of receiving early knowledge of developments likely to affect the future of their industry.

One thing which I am afraid tended to hinder the growth of co-operative research in the past was the rather touching belief of many firms that they possessed knowledge and trade secrets which were unknown to their competitors, and that this might be revealed if they collaborated in research. The manner in which firms had to work together in the war has done much to destroy this fear. An interesting side-light on this matter are the remarks of the managing director of one of our leading aircraft firms. He said "When the war began, we thought that we knew a great deal more than our competitors, but when we were forced to share our knowledge with them, we found they knew about just as much as we did and that the gaps in their knowledge and ours were about the same. What surprised us all still more was that when we had to share our knowledge with our American allies, we again found that the gaps in their knowledge and ours were just about the same."

CONCLUSION

Perhaps I may be permitted to devote the last section of my discourse to personal views rather than to factual matters. I strongly believe that the scientific life should be one of intellectual adventure. It seems to me that this can characterize it whatever its objective. We must recognize and encourage the enthusiasm of the chase as well as the attainment of the objective. I also want to break down the old false barrier between the so-called pure and applied divisions of science, for the whole field seems to me essentially one and its parts are inter-dependent. We are sometimes sufficiently aware of possible practical applications not too far-distant for such recognition to influence our choice of subject. But we must beware of too much restriction of the scientific front. That is the way of arrogance and folly. Man is not all-prescient; and nature has many surprises.

As to the scientist himself, I believe that he should serve, and not dictate to, mankind. But he has the important dual mission, not only of uncovering nature, but also of interpreting it to his fellow men. Then, the consequences of scientific effort being understood by the community, any vital decisions on use must be taken together. Science is too serious a matter to be left to the scientists.

But here I am bound to confess that I see a certain danger, at any rate in my own country. I cannot but feel that there is a tendency in our educational system for scientific specialization to be introduced too soon. A scientific man should also be the complete "citizen of the world". He should not only be fit to live, but also fit to live with. This can only be brought about if his later specialized training is based, and continues to be based, on a broad cultural background. Only in this way can the scientist enjoy the necessary human fellowship with the rest of mankind. But with science destined to play such a vital part in moulding the future of our civilization, it seems to me essential that, in a democratic community, the public, who ultimately should control the destiny of the nation, should make its own effort towards understanding. Too often, and most regrettably, the average citizen is apt to associate science with magic and with something that gets into the headlines.

As a first step in this direction I feel that we should start with our educational system which, I think all would agree, should not be merely an implement of vocational training. It is not necessary to be a maker of science in order to understand its history, its content and its significance. There is a recently published American book which has made a great impression on many minds in my country. It is entitled "A State University Surveys the Humanities" and consists of a series of essays by members of the staff of the North Carolina State University. Among the many thoughtful and thought-provoking contributions to this scholarly volume there is one entitled "The Biological Sciences: The Sciences in the Humanities" by Dr. Robert E. Coker, who is strongly of the opinion that the general cultural value of science is not sufficiently appreciated in universities. He deplores the cultural distinction which is drawn between the arts and the sciences and believes "it arose and has persisted in part from the overconfidence of some scientists who have proclaimed a self-sufficiency for science. It derives also from the narrowly restricted vision of those who would teach the sciences as if they were useful only to equip individuals for earning a livelihood or to enable mankind to have more gadgets and physical comforts." In another passage in the same essay Dr. Coker enunciates his main thesis simply and boldly. "The sciences", he claims, "take high rank among the humanities." I believe he is right if the sciences are taught as they could be and should be.

The Foundations of Freedom in Science . . . .

. . . . *M. Pola*

Whenever the basic institutions of science are at issue, scientists will find it necessary to reconsider with care the need for freedom in science and may wish to state the case for freedom and defend it before a wider public. There will thus arise a new interest in the deeper nature and justification of freedom in science.

Issues far outside scientific life will help to foster this interest today. The value that men attach to freedom has plunged our generation into a deep dive from which it is only climbing precariously out again. Scientists may want to help the world on its way back to freedom by making known how freedom operates in science.

THE NATURE OF FREEDOM IN SCIENCE

Freedom in science assigns to each mature professional scientist the task of conducting research with the aim of making the greatest possible contribution to science. Such a responsibility is a heavy one; but it is a free responsibility. The mature scientist chooses his subject at his own discretion and pursues it day by day in the same discretionary manner. He draws his own conclusions and stakes such claims as he thinks right. At no point of his research work is he subject to any specific instructions from any superior authority.

Freedom of scientific research is in harmony with some intensely personal impulses. The choice of a problem, its pursuit and final conquest are manifestations of the individual scientist's passion for discovery. They bring into play intellectual powers which are otherwise hidden and assert creative forces of a unique kind. An individualist philosophy would regard these personal impulses as the justification for freedom in science. But I find such a view rather superficial. For, clearly, not every strong personal impulse can claim respect and it remains therefore to be shown why those of the scientist should be respected.

A more fundamental approach is gained by examining what may be called the coordinative functions of freedom in science. A statement submitted recently by Dr. Enrico Fermi to the Senate Hearings on Science Legislation defines this function as follows:

"Experience has indicated that the somewhat haphazard exploration of the field of knowledge that results from an intensive freedom of the individual scientific worker to choose his own subject is the only way to insure that no important line of attack is neglected."

We have here a plea for freedom in science on the ground of social efficiency. The discretionary powers which a system of freedom grants to scientists are said to constitute the only effective machinery for co-ordinating the efforts of individual scientists to the joint purpose of the advancement of science.

Now, usually one thinks of co-ordination as a process imposing restraint on the discretionary powers of individuals. Much of my argument will be concerned therefore with finding out how co-ordination is achieved in science by the opposite method of releasing the individual impulses in question.

THE COORDINATIVE FUNCTION OF FREEDOM

A first step towards the answer is easy to find by throwing a glance at a group activity in which co-ordination is totally absent. Take a number of people shelling peas. There is no occasion here, and no possibility, to adjust the work of one person to the work of another, for the value of their total achievement is simply proportionate to the sum of the peas shelled by each. Science cannot be conducted by such isolated efforts. Suppose scientists were kept a few hundred years strictly without any mutual communication. The total discoveries achieved by them would be little more than what is normally gained by science in a few years. No continued systematic growth of science would take place at all.

The co-ordinative principle of science is thus seen to consist in the adjustment of each scientist's activities to the results achieved by the others. Since such mutual adjustment depends on the independent decisions of each, its operations require the complete freedom of all.

It would seem that we are faced here with a basic principle leading quite generally to co-ordination without intervention of any co-ordinating authority. It is a simple principle of logic which can be demonstrated on quite trivial examples. Consider the piecing together of a jig-saw puzzle, and suppose we take a very large puzzle which would take one person a number of days to piece together. Assume further that we had a dozen players who would like to help. It would obviously be of little use to give to each a separate set of the puzzle to work on it in isolation, but it would greatly speed up the solution if all participants were allowed to work on the same set, each taking note of the results of the others and using them as their starting point.

The logic of this form of co-ordination can be reduced to even simpler t
For every mathematical calculation c
ried out by successive stages of ap
mation may be taken to illustrate it.
step in such a computation deals wit
phase of a problem at a time and
on the results of the earlier steps.
becomes particularly clear if we thi
problems in which each step is ope
at a different point in space. A co
example of such a polycentric probl
the distortion of a rigid framewo
joists pinned together at a large
ber of points. Given the elastic prop
and the distribution of loads over a
pinpoints, the solution can be fou
the "relaxation method" which co
in calculating the displacement of
pinpoint in turn in respect to its
bors, the position of these being ass
for the moment as fixed. In passing
one centre to the next the displace
previously calculated for the othe
always taken into account. If a
number of such calculations had
quickly made for a given rigid f
work, we could employ a team o
culators, and place each in charge o
particular pinpoint. They could all
working independently merely noti
each other of their results and mu
taking these into account.

We have reduced here to the sin
terms the co-ordinative function of
dom. It seems to be based on the
that in certain cases a joint task ca
achieved by a group of participants
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intensely personal impulses and an e
ceptional degree of creative judg

Such a statement however, woul
seriously incomplete as it would fa
take into account the characteristic v
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exists a task of piecing together a j
saw puzzle, or of solving a polyce
mathematical problem, the task of sc
cannot be said to exist at all. If we a

A speech delivered at the Bicentennial Celebration of Princeton University.

understand spontaneous self co-or-ation in science we must yet discover hat sense there does exist a common of science.

ur first reaction may be to look for efinition in terms of explicit premisses erlying the scientific interpretation nature. But there exists no strict set suppositions on which scientists are eed and have been agreed through-the past centuries. Whatever premisses be held in common among scientists are not to be found formulated in nite precepts. They can therefore be to exist only as implied in the prac- of scientific enquiry. To the exam-ion of this practice let us therefore .

E COHERENT TRADITION SCIENCE

is clear that the coherence of science nplied in every affirmation of discov- by a scientist. A claim to discovery resses the scientist's conviction of ng gained an element of truth which r scientists are bound to recognize; his claim is also usually based on his gnition of discoveries made by other ntists. Moreover every new discovery ns to form an addition to the system cience as transmitted from the past. re is inherent therefore in each new n to discovery the practical affirma- of a coherent system of truth which pable of indefinite extension into yet xplored regions.

or the extension of this system scien- rely on methods embodied in the mon practice of research. Scientists pt, utilize and transmit certain tra-nal procedures and standards. They ld certain traditional ideals.

his dedication of scientists to the ad-ement of an intellectual process be- their control and to the upholding alues transmitted to them by tradi- represents the sense in which science possess and pursue a coherent task. rnatively, we may express the ex-ce of such a task by saying that ntists form a community believing certain spiritual reality and cov-ted to the service of this reality.

hose who—whether within science or de science—subscribe to these be- and underwrite this covenant affirm mplication the presence of a spon-ous co-ordination of independent ive impulses in science. They uphold dom in science. Those who deny such physical beliefs and repudiate such scendent obligations deny by logical cation also the possibility of both coordination and freedom in science. may not act by this logic but the cation remains true.

SCIENTIFIC OPINION AS GUARDIAN AND GUIDE

The organized forms of scientific life, publications, university posts, research grants and scientific distinctions form a system of opportunities and restraints for the pursuit of science. This system is governed by scientific opinion. Scientific opinion prevents cranks, frauds and habitual blunderers from gaining ground in science. At the same time it apportions credit to valid contributions, appraising and supporting their authors according to their merits. Those disciplinary and administrative actions are indispensable to science as cultivated today by thousands of contributors. By performing them, scientific opinion enforces the coherence of science, which is the basis of its freedom.

We can clearly see now the inadequacy of the individualist theory of freedom in science. Individual impulses are respected in science only insofar as they are dedicated to the tradition of science and disciplined by its standards.

Modern science depends for its material existence on support from outside. Scientific opinion which watches over coherence and freedom from within science cannot fulfill this function unless its decisions are respected outside science. In allocating their support to different scientific purposes, outside authorities must accept the guidance of scientific opinion. They would otherwise inevitably disrupt the coherence of science and undermine its freedom.

CONFLICT WITH EXTRA-SCIENTIFIC AUTHORITIES

Such are the foundations of freedom in science. It is easy to see why they may be called in question in the world today. The autonomy of science cannot be recognized by any government which denies transcendent reality to science. Inevitably, such a government will come in conflict with the autonomy of science.

Similar dangers may arise more incidentally wherever the responsibility for the expansion of scientific institutions falls to public authorities who are not sufficiently familiar with the nature of science. As guardians of the public interest they may feel reluctant to leave to scientific opinion full control over public funds allocated to science. Dazzled perhaps by the achievements of applied science in wartime—which had, quite rightly, been placed under the direct control of the political authorities—they may fail to recognize clearly the different nature of the quieter pursuits of pure research and not realize that these can be maintained only in complete independence.

THE CONCEPT OF FREEDOM IN SOCIETY

In my introduction to this paper I have said that by defending the foundations of freedom in science we may help people to recover a clear conception of freedom in general. The theory of scientific freedom which I have just outlined might indeed be found capable of extension to other fields of social life. There are other realities of the mind besides science and there exist transcendent obligations other than those which are particular to scientists. There exist great traditions which embody these realities and these obligations and which comprise all the main roots of our civilization. We have our tradition of intellectual honesty, which came to us from the Greeks; that of brotherhood, which we derived from Christianity; that of legal reason, which was the heritage of Rome; and that of tolerance which we were taught by Milton and Locke.

All these traditions form, like that of science, the premisses for an indefinite sequence of individual creative actions. Actions which are, or at least tend to be, spontaneously coherent, and the unrestrained interplay of which forms the constitution and essence of a free society.

The foundations of coherence and freedom in general may therefore be regarded as secure to the extent to which men uphold their belief in truth, justice, charity and tolerance and do in fact accept dedication to the service of these ideals. While on the other hand society may be expected to disintegrate and fall into servitude when men deny, explain away or even simply disregard these realities and transcendent obligations.

Disintegration may follow on the one hand the path of an individualist theory of freedom resulting in romantic self-love and civic indifference. Concurrently we may find that the institution of government is interpreted in terms of force, and that history is represented as the process of one clan liquidating another and one nation eliminating another.

Within such an outlook the ideal aspirations of man are rendered homeless. Fearing to confess themselves for what they are they seek embodiment in some social or racial theory of isolence. Thus we see arise that sceptical hard boiled form of fanaticism which is so characteristic of our age.

Man's rapidly increasing destructive powers will soon put the ideas of our time to a crucial test. Unless we radically re-affirm today the philosophic foundations of our civilization, the logical outcome of their present inadequacy will not be delayed for long.

The British Atomic Energy Act . . . .

As reported in Bulletin last month, the British Atomic Energy Bill was passed by the House of Commons on October 11 and is now awaiting passage in the House of Lords. The following summary of the Bill shows the similarities and the differences between the American and the British legislation.

PROVISIONS OF THE BILL

The "Atomic Energy Act 1946," the British counterpart of the McMahon Bill in the USA, contains 21 clauses. The following official memorandum summarizes their provisions:

The objects of the Bill are to empower the Minister of Supply to promote the development of atomic energy and to confer on him powers of control over the unauthorized production or use of atomic energy and over the publication of certain information.

The Minister is charged by **Clause 1** with the general duty of promoting and controlling the development of atomic energy (which is defined in Clause 18) and by **Clause 2** is given power to produce and use atomic energy, to carry out research, and to produce, handle and deal in any necessary articles. (The right to dispose of the energy produced was added in the House).

The Minister is empowered under **Clause 4** to obtain information concerning any materials, plant or processes connected with the production of atomic energy, and by **Clause 5** to enter and inspect any premises where he has reasonable grounds for believing that work on atomic energy is being conducted or that materials or plant relating to atomic energy are situated.

The Minister may search for minerals from which uranium and other prescribed substances (as defined in Clause 18) can be obtained **(Clause 6)** and may, by order, vest in himself the right to work such minerals and any ancillary rights necessary for such working **(Clause 7)**. Any order under Clause 7 will provide for compensation.

Clauses 8 and 9 enable the Minister to acquire compulsorily, but with provision for compensation, any materials, plant or contractual rights connected with atomic energy.

By **Clause 10** the Minister is given powers of control, by order, over the working of any minerals from which the prescribed substances can be obtained, and over the possession and movement of any of the prescribed substances or of any plant connected with atomic energy; but the Minister is to ensure, so far as practicable, the availability of materials and plant for research and educational purposes and for commercial purposes not related to atomic energy.

Clause 11 restricts the disclosure, without the consent of the Minister, of information concerning any existing or proposed plant for producing or using atomic energy. (This clause is given in full below).

Special provisions regarding inventions in relation to atomic energy are contained in **Clause 12.** The Comptroller General of Patents, Designs and Trade Marks is required to prohibit or restrict the publication of information concerning an application for a patent of this nature, and to notify the Minister, serving a copy of the notice on the applicant. The Minister may inspect the deposited documents; and, if he is satisfied that the invention is not of importance for purposes of defense, the ban on publication will be lifted by the Comptroller General. In addition, the clause prohibits, except with the written permission of the Comptroller General, the making of applications outside the United Kingdom, by a person resident therein, for the grant of patents in respect to such inventions, unless application for a patent for the same invention has already been made in the United Kingdom, and either no ban on publication has been imposed or any such ban has been lifted.

The powers of the Minister are extended by Clause 12 so as to include power to make, use, exercise or vend an invention for purposes relating to atomic energy; and the Minister may authorize the use of any drawing, model, plan or other document or information.

Clauses 13-21 contain "General Provisions." Among them **Clause 14** provides as punishment for individual offenses under the act, on conviction or indictment, penal servitude for not more than five years or a fine not exceeding 500 pounds, or both. Corporate bodies can be fined any amount the court thinks just, and their directors, general managers, secretaries and other officers are individually responsible for such offenses. **Clause 15** provides for Parliamentary review of all orders issued by the Minister under the act, with the right of either House to annul any one of them within 40 days after it has been laid before the Parliament.

Clause 18 gives the following definitions:

"atomic energy" means the energ leased in any process, including th sion process, which involves the formation of or reactions between a nuclei and has been influenced by s arrangements of matter or by othe plied means, but does not include e released in any process of natural mutation or radio-active decay whi not accelerated or influenced by ex means;

"minerals" includes all subst obtained or obtainable from the so underground or surface working;

"plant" includes any machinery, ment or appliance, whether affixe land or not;

"prescribed substance" means ura thorium, plutonium, neptunium or a their respective compounds or any other substance as the Minister ma order prescribe, being a substance wh his opinion is or may be used fo production or use of atomic energy search into matters connected there

FINANCIAL EFFECTS OF THE BI

It is not possible in the present of development of work on atomic e to give an estimate of the total exp ture which may be incurred under the

The principal expenditure will from the exercise of the powers o Minister under Clause 2. Expend of the order of 30 million pounds c present be foreseen, but no figure c given for the moment which may ulti ly be involved.

Under Clause 3, the Minister may grants or loans to encourage wor atomic energy; the Minister will be to pay compensation, under Clause damage caused by any work done fo purpose of discovering minerals under Clauses 7, 8, and 9, for any pulsory acquisitions effected there but no estimate can yet be made o amounts likely to be involved.

THE SECURITY CLAUSE; STAND OF THE BRITISH ATOMIC SCIENTISTS

A memorandum expressing ce criticisms of the Bill was prepare Profs. Peierls and Massey and circu among the members of the Associ on July 8.

Of the four points of criticism ma the memorandum, the two most seemed to be the lack of statutory vision for technical advice to the Min

the far-reaching secrecy provisions Clause 11, the latter being closely bound with the wide definitions contained in use 18.

The Association's officers explained e views to members of the House of mons, to the general public by way letter published by the "Times" on October, and to the Ministry of Supin person on 10th October.

he views of the Association of Scien- Workers were very similar, and a ber of members of the House strongly ed the Government to agree to amendts in the senses proposed by the ciations. These efforts to amend the were almost entirely unsuccessful, e new Government amendments have e the Bill still more restrictive—icularly by the deletion of the subion Clause 11 that would have exted from secrecy restrictions any t designed solely for scientific rech and educational purposes.

ause 11 now provides:

Subject to the provisions of this on, any person who without the con- of the Minister communicates to any r person any document, drawing, ograph, plan, model or other informa- whatsoever which to his knowledge ribes, represents or illustrates

any existing or proposed plant used roposed to be used for the purpose of ucing or using atomic energy;

the purpose or method of operation of such existing or proposed plant; or

any process operated or proposed to operated in any such existing or osed plant;

l be guilty of an offense under this

rovided: that it shall not be such an ise to communicate information with ect to any plant of a type in use for oses other than the production or use tomic energy, unless the information oses that plant of that type is used roposed to be used for the production se of atomic energy.

The Minister shall not withhold con- under the last foregoing subsection, e is satisfied that the information osed to be communicated is not of rtance for purposes of defense. is provision was added by the Minis- in Committee to replace the deleted ision—referred to by the Atomic ntists Association—which provided an exemption of plant designed only scientific research and education).

The Minister may by order grant exemption from this section in such classes of cases, and to such extent and subject to such conditions, as may be specified in the order.

(4) Where any information has been made available to the general public otherwise than in contravention of this section, any subsequent communication of that information shall not constitute an offense under this Act.

The Minister has promised "to free the ordinary laboratory tools of the research physicist which have no defense significance by excluding them from the terms of any order that he may make under Clause 10; and, as soon as the Bill becomes law, to confer with the physicists and scientists who will be affected, with a view to making an Order under Clause 11 to exclude those tools from the categories of plant about which communication is forbidden."

THE SPEECH OF PRIME MINISTER ATTLEE

The Bill was introduced by the Prime Minister, Mr. Attlee. Following are excerpts from his and other speeches in the House of Commons on October 8:

"I am quite sure hon. Members in all parts of the House will recognize the unique military, economic and international importance of this subject, and that those very unique conditions require very exceptional legislation.

"The full economic significance of atomic energy is not yet known. I do not think anyone has any doubt that there is here a possibility of revolutionary changes. Therefore, I think hon. Members of all parties will agree that development in this country is a prime responsibility of the Government. Today, we are not concerned primarily with the question of international control. That is a matter which is being worked out in the Commission set up by the United Nations organization. I do not think there is sufficient awareness, perhaps, of the dangers in this country. I am quite sure that that awareness is not quite so acute as it is on the other side of the Atlantic. But we have been watching with anxious care the deliberations of the Commission; and this Bill before the House, in one of its aspects, is an earnest sign of the Government's determination that the United Kingdom shall be ready to play its part, its full part, in any international scheme.

"This Bill has no background of political bearing. It is forced upon us by the very nature of this new invention. We are not introducing a sudden Bill for nationalization. We are taking the steps which any Government must take in dealing with an invention of such immense potential destruction. In fact, the task of development could not really be undertaken except by Government. There is, first of all, the very large expenditure in money and materials. There is uncertainty as to the results; and there is, of course, a thing we must watch all the time—the danger of disastrous accident if there were uncontrolled experiment.

"As the House knows, the Government have already set up a large research establishment, and we are arranging for the production of fissile material for that establishment, and for other purposes; and the responsibility has been placed with the Minister of Supply; and this Bill will give him the necessary powers to discharge that responsibility. The programme of work already approved will cost something like 30 million pounds, but the programme is being kept constantly under review, and it may well be that expenditure on a far greater scale may be necessary if we are to play our proper part."

The Prime Minister then reviewed the single clauses. Coming to Clause 11, he said:

"I draw special attention to Clause 11, which places restrictions on the disclosure of information. The production of atomic energy involves very complicated proccesses, it is really a major industrial effort, and until we can get international control, what is sometimes called the industrial 'know-how' must be kept under control. When I was in America the declaration made by the President of the United States, the Prime Minister of Canada and myself laid down this policy: until we can get the introduction of effective and forcible safeguards, there must be power to prevent the dissemination of information as to what is called the 'know-how'.

"We are presented with a rather difficult drafting problem as to where exactly to draw the line, where to get the security we need without impeding scientific research, and the conclusion we reached was that we should define in the Bill the information which should not be communicated concerning the energy plants, what they do and how they work, the provision for excluding information about plant in use for purposes other than atomic en-

ergy, provided that the connection with atomic energy is not disclosed. Our desire has been to make the thing watertight by giving the Minister full powers, including power to authorize a relaxation in particular cases. Also we desire to take away the onus which, as the Bill is drafted, rested on persons, requiring them to give information without knowing quite whether the information was right. As the Clause will be amended in Committee, that onus will be on the Minister. We also provide that where information has once been made available to the general public, if it is not in contravention of the Bill, it is freed from further control. We expect that in course of time there will gradually emerge classes of information which may be published. As a matter of fact today the great bulk of the technical information is necessarily in Government hands. It has been the result of work in Government establishments or under Government control, and there is there, therefore, the additional safeguard of the Official Secrets Act. If hon. Members will examine this Clause, I think they will find that it hits the mean between not giving away information that will endanger our security and, at the same time, not being unduly restrictive of scientific research."

Mr. Blackburn (Birmingham, King's Norton): Would the Prime Minister deal with the point that, instead of accepting the distinction which he pointed out earlier between fundamental research on the one hand and industrial 'know-how' on the other, the Clause is now so drafted as to cover the whole field, both fundamental research and industrial 'know-how' as well?

The Prime Minister: I do not think so.

THE OPPOSITION SUPPORTS THE BILL

On behalf of the opposition, the Bill was supported by Mr. Richard Law. He said, in part:

"This Atomic Energy Bill resembles with extraordinary fidelity the general run of Socialist legislation. In this Bill, as in all other Bills, the Government establish a monopoly. In this Bill, as in those other Bills, the Government endow a supposedly all-wise Minister with absolute and final authority. Here, as in other Bills, vistas are opened up of forms to be filled in, declarations to be made, inspectors to be placated, and so on, and compensation, not very clearly defined, is to be paid for those whose rights or property is wrested from them by the State. It is very much on the old model. Nevertheless, we on this side of the House propose to give our support to this Bill, even though it does resemble so very closely some other horses which have come out of the same stable and have not been conspicuously successful at recent race meetings.

"I think there are two main reasons why the House should give a Second Reading to this Bill. No layman can say with absolute finality and dogmatism that there will never be any physical, mechanical answer to the atomic bomb. It is conceivable, I suppose, that the same ingenuity which produced the bomb may, in time, produce its antidote. What we can say, and must say now, is that it seems unlikely in the physical field that there will ever be, as far as we can see, a complete antidote to this weapon. We are therefore left to look for a solution for defense—because we must have a defense —not in the physical field but in the political field. The only final defense I can see in the political field is some valid international agreement for the establishment of an international authority for the control of this new weapon. That is really the only ultimate defense. It is clear that it is going to be impossible to establish international control unless first we have established national control. This Bill is therefore the essential prerequisite of the final solution, if ever in fact we do reach a final solution. That is one reason why I suggest that the House, irrespective of party, must support the Bill this afternoon.

"The second reason is this. We are at present in a kind of interim position. We have not yet achieved a valid international agreement, no international authority has been set up, and with the limited information at my disposal I cannot see that there is any immediate prospect of such an authority being set up. From every point of view, from the point of view of the economic, medical or scientific development of this invention, as much as from the point of view of defense, we must ensure as far as we humanly can that we in this country, our scientists and our industry, are abreast of anything that is being done in any other country. That for the moment is the only solution which is left open to us during this interim period pending the establishment of an international authority.

Protests Small Science Representation in UNESCO

Prof. W. A. Noyes, President-Elect the American Chemical Society, rece directed the following letter of pro to Ass't. Sec'y. of State William F. B ton:

Dear Mr. Benton:

I have received the list of members the United States National Commis on Educational, Scientific, and Cult Cooperation as well as the list of offic including the executive committee, were elected by the Commission at its meetings.

Among the members of the Commis there seem to be only seven who coul said to represent science at all. Of t seven, three are university presidents, are engineers, one a biologist, and seventh, also a biologist, has retired f active life. Therefore of the seven, engineer and one biologist may be sai be actively engaged in scientific w today. This is the total out of a list of

Of the officers elected by the Com sion, one vice president is a physicist, a university chancellor no longer enga in scientific work, and none of the ot are scientists.

Among the list of societies asked appoint delegates, only one is a large entific society which might be said to resent any considerable group. Even one is supported mainly by biologists geologists and cannot be said to repre to any great degree chemists, physici and engineers.

The situation created by the very sm representation of scientists both on Commission and among the officers i most unfortunate one. Scientists as group tend to believe strongly in int national cooperation, and indeed, scient cooperation throughout the ages has b one of the few unifying influences. matters stand today, however, it is dou ful whether you can count on the supp of scientists for UNESCO. The execu committee is largely dominated by bu ness men and professional educat Those of us who have been ardent supp ers of UNESCO are now confronted w a serious problem and our course of act in obtaining international cooperation by no means clear. However, it is evid that we would be wasting our time supporting an organization where viewpoint of science is not fairly repre sented.

W. Albert Noyes, Jr

Letters to the Editor . . . .

Personnel of the Atomic Energy Commission

. . . . Otto Beyer

The Commission to be appointed under he provisions of the Atomic Energy Act f 1946 will have the responsibility of ringing into being a new and basic inustry—the production of atomic energy. t will also have the task of guiding the tilization of this energy into socially useul channels.

How profoundly the production and use f atomic energy can affect the future f the Nation is evidenced in the language nd scope of the Act. In this legislation Congress empowered the Federal Govrnment to control the production, ownerhip and use of fissionable materials and rovided the broad outlines of a program f administration designed to effectuate he Act's purposes.

Important phases of this administraive program were written into law in rder to prevent the leakage of vital nformation, to assure the loyalty of emloyees, and to grant the Atomic Energy Commission discretion in the employment f key personnel without regard to the mitations of the Classification Act.

But neither the expressed purposes of he Act nor the legal safeguards which t provides are in themselves sufficient to nsure that the production of atomic enery for peaceful uses will be achieved in he most effective and expeditious maner. That result depends upon the selecion of administrative and operating personnel who not only are loyal to the Fedral Government but who also are moivated and inspired by a consciousness f the immensity and potentialities of he task ahead.

This applies, it goes without saying, to he Commissioners and the General Manger, whose selection and appointment is he responsibility of the President and he Senate. It is equally the case as to the Division heads called for in the basic aw and the many administrators, superisors, and employees who must be hired y the Commission.

The object of this article is to focus ttention upon the importance of establshing personnel policies and practices esigned to evoke from the men and vomen who will be engaged in this great xperiment the wholehearted devotion so ecessary to success.

Some of these policies and practices eed no particular elaboration. Clearly nough, responsibility for personnel adninistration must be centered in a branch r department established for the specific urpose. Such a department would be harged, in collaboration with the appropriate agencies of the government, with recruiting and selecting personnel. It would, in this connection, develop job classifications and descriptions and establish the required system of personnel records. It would have the primary responsibility for developing techniques of indoctrination and training for new employees and of in-service training for persons already in the service.

The personnel department would also be concerned with stimulating health and safety measures in the plants and offices of the Commission; with housing, recreation, and related matters incident to employment; and with the determination of labor standards, including working rules, rates of pay for unclassified and special presonnel, and methods for the adjustment of grievances.

In addition to these conventional—and highly important—activities, the personnel department should be given the broad duties of leadership in promoting an essential development—procedures for systematic cooperation between employees, their organizations, and representatives and the supervisory and administrative staffs of the Commission. In this lies perhaps the most significant opportunity for furthering in every phase the public purposes stated in the Atomic Energy Act.

Fortunately, the blueprints have already been drawn for the kind of comprehensive personnel policy suggested here. On the Canadian National Railways, the Tennessee Valley Authority, and the Bonneville Power Administration—all of them pioneers in the public administration of national resources—bold, constructive, and forehanded action has paved the way to new concepts of human relations in industrial enterprises. The lessons learned in these undertakings can be of the greatest value both in insuring against future deterioration of personnel relations and in assuring that the work of the Atomic Energy Commission will get under way with maximum efficiency.

The chief argument for an early and aggressive personnel program, however, is not the prevention of future difficulties or the selection of a competent group of people. It is rather the inauguration of policies, standards, and methods which will build up to the highest possible level of organizational morale. It is definitely within the power of the Commission itself to shape the course of events toward this positive and eminently desirable goal.

In many respects the production of atomic energy offers an even more challenging vista than did the establishment of huge public power developments or the operation of a railroad covering half a continent. This fact should be seized upon as the basis for creating within the organization under the Atomic Energy Commission a spirit of cooperative endeavor in a vital mission. Such an atmosphere will do more than any other single thing to guarantee the full realization of the potentialities for national and international welfare in the release of atomic energy.

Our Publication Policy as Seen from Abroad

. . . Victor F. Weisskopf

The situation among scientists outside the United States seems to be very critical. From my contacts with people from outside, I am left with the impression that the foreign scientists believe that American scientists are completely enslaved by the American Government and by the armed forces. This is primarily due to the misconceptions created abroad by the recent Army and Navy research contracts. Foreign scientists believe that the purpose of these contracts is to force our scientists into work on weapon development.

They admit that we have the good will to improve the situation, but they think we are completely powerless. Therefore, they, for the most part, discount any help from our side; they believe they will never get any information of a scientific nature out of this country even on subjects that have been declassified. Perhaps a characteristic example of their attitude can be found in a recent issue of the British Medical Bulletin which contains a great deal of information on radiation problems. This Bulletin lists its distribution sources from all over the world, but does not mention any in the United States.

Much could be done to improve this situation; for example, by accelerating the declassification of declassifiable material and by sending this material as soon as possible to foreign scientists. There is a danger of creating a bloc of all foreign scientists against us, wherein they develop their own ideas and their own plans, discounting any collaboration with America. This attitude is understandable in view of the present state of world affairs. However, if it is not changed, it will be very harmful for any international understanding.

The Scientists' Role in International Relations

. . . . *H. A. Kramer*

The life of us human beings on this earth is a complicated affair. I suppose you are all aware of this. I suppose also that many of you are worried by this complexity, at any rate by certain aspects of it. Why are you worried? There may be different reasons. Maybe it is your personal affairs and those of your family which need your attention: they confront you with a task which is difficult to fulfill since the problems are *so* complicated. You do not know what to do about them and at the same time something must be done. That's what worries you.

Another type of worries take their origin in the complexity of affairs which pertain to larger groups of people. If you are a university man it is your job, your duty, to attend to such affairs. You are expected to take decisions, to take action with regard to your students, to your collaborators, to your laboratory. Some of you will have a natural, or an acquired gift to tackle the difficulties which arise here, and your worries need not be overwhelming; others will constantly suffer.

Finally, let us think of human affairs, the complexity of which worries you although nobody asks you to worry about them. Social affairs of wider scope may belong to this category; questions of the administration and government of your town, of your state, of your country, and last but not least: international affairs. There may be things which you disapprove of and about which you think something ought to be done; people, who in part are responsible for the situation and who are in a position to take action do not take action or take action in a way you think is bad. You might belong to those, who—gifted with true or false insight—know at once what ought to be done about such affairs, but you might also be one of those, who have tried to analyse the situation in—say, a scientific way and who thereby have realized its complexity. Then you may start to worry, in a way—perhaps—which leaves you no peace and you may well become jealous of those who disregard the complexity and admire their courage when they take action in the way which Alexander tackled the Gordian knot. But all of you will realize that admiring Alexander does not mean that you approve of him.

Now the Gordian knot was not a social, a human affair. The complexity of affairs of the latter kind derives a good deal from the amazing, the queer and the discouraging characteristics of man himself. From his intelligence and his lack of intelligence, from his morale and from his lack of morale, from his egotism and from his devotion to others, from his desire for war and his desire for peace, from his lust to rule others and his ability or incompetence to rule others.

Compare this complexity with the complications which the *scientist* meets in his own dear field. They are often so bad that he is inclined to omit the adjective "dear." His passion to hunt in his field has perhaps in the beginning been urged by some kind of love, but look how often this love turns to anger. He is like the hunter, who gets very angry at the lion he loves to hunt. But anyhow, in all his worries, the only personality, the only psychology he has to cope with is his own; the object with which he deals is inhuman, has no good-will or malice, even if he often may be inclined to think of the sphinx of nature, with whom he is wrestling, as a fellow-being, the relations with which are constantly changing. He pats her and she scratches him; he scolds her and, look, how nice she then often can be. The better he knows how to handle her, the less he understands her, in accordance with what the French poet, Henri de Reguier, said about women in general.

But let us leave this personification of nature out of the picture. Let us come to the theme which has brought us together this evening—the scientists' role in international relations. You will have felt in what spirit, and perhaps also in what mood, I have tried to approach this theme. Here we have the *scientist*, who is accustomed to cope with inhuman affairs of extreme complexity, and who starts to worry about international relations, the complexity of which is so greatly enhanced by its human aspects.

Two questions arise. The first is: why are there, in these times, more and more scientists who really are assailed by such worries? And the second is: what can he do and what shall he do about it? And what hopes may he cherish?

As regards the first question, you get the answer by considering what science has been and what scientists have been in the course of the history of civilization and to what point we have come now in the course of the evolution of science.

In old days, say two or three hundred years ago, scientists worked as separate individuals who collaborated through their letters, through their books and throu their occasional meetings, small ants i the ant-heap of human affairs, whose rect spheres of activity were small, ho ever big the final outcome of their wo might be for human civilization. In th work they hardly needed to pay attent to the eventual outcome, and they had more reason than any other citizen worry particularly about national international affairs. Christian Huyge the Dutch physicist of the 17th centu paid hardly any attention to national international relations. He felt hims as naturally belonging to the internatio brotherhood of learned men, which h an attitude of more or less outspoken c tempt with regard to matters politic When Louis XIV in 1672 made an agr sive war on Holland, he stayed peacefu in Paris. No need for him to pay attenti to those wars: he was too busy anyho Simon Stevin, of Bruges, who lived h a century before Huygens, was much mo what we would call now, socially mind but he was so by inclination. He help his master, Maurice of Orange, to bu fortifications; he also wrote a treatise house planning from which his worryi about social conditions becomes clear. his case it was not the outer circu stances which dragged him, as a scienti to the scene of human affairs—and t technical aspect of these affairs was ways foremost in his mind.

In our times, however, things are different. As one of my colleagues Leyden expressed it, science has more a more been making toys—toys, howeve which they are not allowed to play wi themselves; their big brothers, that the rulers of this world, have appropriat these toys, and used them for all kinds purposes, and many of these purposes a not so very nice. We scientists have b come very conscious of the fact that o efforts eventually will lead to resul which are apt to modify the living cond tions of mankind on our earth. Seei this, our social conscience is awakene and we hope that these modifications w be for the good and not for the worst. M Leyden colleagues expressed it like thi we wish that it be left to us to play wi the toys we made ourselves. This is ce tainly an over-simplification of the pro lem. We do not want, we have no tim most of us at any rate, to play ourselve but we feel a certain responsibility an want to see that the toys we made ou selves are used in the right way, nationa ly and internationally.

And here we become confronted wit

An address delivered at the Bicentennial Celebration of Princeton University.

the second of the two questions mentioned above. What can we do and what shall we do, and what hope can we cherish about the outcome of our activities? Now some us may beforehand be conscious of our incompetence regarding the task which dawns before us, or we may be cowards or egotists and shut ourselves up n our rooms as well as we can. Others among us may gird their swords and run to partake in the battle. And these will soon see, or ought to see, with their scientifically trained minds, the complexity of he problems before them.

This complexity I have mentioned at he beginning of this talk. There I pointed ut how this complexity was due in large part to the human element in group relaions, especially in affairs of international cope. We poor scientists who want to ake part in the battle will have to undertand human behavior, and woe to us if he natural gift for doing so is lacking n us. But if we have it, what can we do nd what shall we do?

I hope you do not expect a definite anwer from me tonight. I will only try to ive two indications of the way to follow. The first is that we should take advantage f everything which the occupation with ur own science has taught us. That is, ve should study with patience all facts, urn them over and over, and we should ot scorn or overlook *details* since we now that from the consideration of deails the solution of the big problem often as emerged. On the other hand, patience hould not mean indefinite postponement f decisions and actions. There is no textook which tells us how to find the right alance between thinking and acting; he ho has the grace will do it well. This ell-balanced scientific attitude may rove, *must* prove, beneficial in all human fairs, in all things political.

The second indication is the following. cience is, as I said above, rather inman; international relations are conminated by their human aspects and erefore so much more complex. But ok here: are things human so much orse than things inhuman? Has not the ord "inhuman" the connection of meang something less desirable than the ord "human"? In human relations we e no longer alone with the riddle of ur own personality. When we are two e may achieve much more than when e are alone, and when we are many, how g is the promise that groups of people ill find each other and work together at problem, which no single man can solve? human nature lies our worst enemy, t at the same time, it holds out the omise for that friendship which means llaboration and achievements for the ture of mankind.

The UN Atomic Energy Commission

The informal meetings of the Committee 2 of the Atomic Energy Commission continued throughout November, but little transpired as to the subjects discussed. To the report on the first five such meetings, printed in the last issue, it may be added that on October 22, **Dr. G. M. Briggs** (Australia) gave an outline of the occurrence and working of thorium-bearing sands in Australia, and **Prof. Alexandrov** (U.S.S.R.) discussed thorium as by-product of the mining of gold and other minerals in U.S.S.R. It was generally agreed that the wide occurrence of thorium deposits, for instance, monazite sands, on the ocean beaches, and the small scale of mining operations involved, make it more difficult to control thorium than uranium.

In the same meeting, the Secretariat was requested to formulate a draft statement of the problems involved in the setting up of controls over the mining of uranium and thorium so as to prevent diversion of raw materials at the mining stage.

In the seventh informal meeting, on November 4, a general account of the control of chemical and metallurgical processes in industry, was given by **T. H. Critchett** (Electro Metallurgical Company). A working paper on control of thorium submitted by the U. S. Delegation on October 31, was considered, as well as a revised draft of the working paper on the control at uranium mines and mills, prepared by the Secretariat on October 28.

* * *

On November 13, a plenary meeting of the Atomic Energy Commission was held for the first time in four months, to hear a report by the chairman, Mohamed Bey Khalifa (Egypt). He criticized the delays and wrangles in the Commission, and declared the peoples of the entire world were waiting upon the outcome of the Commission's work. He said he believed that during his stewardship "some real progress" had been made toward the Commission's goal and that "in this all the members have cooperated heartily and willingly."

The report asserted that the Commission's Scientific and Technical Sub-committee had reported that from the technological point of view, "control of atomic energy was feasible," and had indicated the "danger points" at which such control should be applied.

"There still remain, of course, major political problems," the report said. It is time that we deal with them."

Colonel Khalifa took note of a "few public expressions of impatience" at the failure of the Commission to reach a final and unanimous conclusion, and reminded the membership that "We cannot leave out of account the words in our mandate that the Commission proceed 'with the utmost dispatch.'"

The report closed with suggestions (1) that the Atomic Energy Commission submit to the Security Council by Dec. 31 a report of its proceedings, findings and recommendations, based upon its deliberations to date; and (2) that the General Assembly Committee 2 (Economic and Financial) be directed to offer drafts for such a report, or parts of it, from time to time, to the Atomic Energy Commission for its consideration and action, all drafts to be completed by Dec. 20.

Bernard M. Baruch, United States delegate to the Commission, expressed "full agreement" with the report and moved that the suggestions be adopted.

Capt. Alvaro Alberto of Brazil and Gen. A. G. L. McNaughton of Canada spoke in behalf of the report and its suggestions. General McNaughton urged that before the change of membership at the end of the year, when three new countries take office, the Commission should convey to a public "naturally concerned" a report on the ground that had been covered.

S. P. Alexandrov, who spoke for the Soviet Union, pointed out that the report had been made available only a few minutes before the session convened, and he said that the time factor raised a problem; that the matter called for preliminary study and that, consequently, he was not in a position to vote for or against.

The French representative, Alexandre Parodi, opposed the Russian interpretation of the time limit in the suggestions, declaring that it did not constitute an "imperative or strict time limit" on the work of the committee in seeking atomic energy control, but involved only the report on recommendations contained in the suggestions of Colonel Khalifa.

M. Parodi also remarked that there were proposals by the United States and Soviet Governments on total disarmament before the General Assembly and that if the Atomic Energy Commission hastened its work, it would facilitate the problems of the Assembly on the disarmament question.

The report and the suggestion were then adopted by unanimous vote, with the U.S.S.R. and Poland abstaining.

The Present Status of Declassification . . . .

In the November issue of the "Bulletin of the Atomic Scientists," we inaugurated a program designed to shed light on the policies of the Manhattan Engineer District with regard to declassification and dissemination of technical information gathered during the war. This program began wth the publication of an outline of the current MED procedures, written at the request of the "Bulletin," by Lt. Col. W. S. Hutchinson, Declassification Officer for the MED.

Our efforts to clarify this problem are continued in this issue. The basic principles that should guide the dissemination of such information are discussed both editorially and in a letter by Prof. Weisskopf.

* * *

Declassification has been in operation for over 6 months. At the present writing, about 600 documents have been classified. However, up to Nov. 28 not even a partial list of titles of these declassified documents had been distributed to scientists, either American or foreign, outside the Manhattan Project.

That small fraction of our scientists within the Project have not fared much better. A list of about 80 titles, dated July 15, and marked "For Distribution Within the Manhattan Project Only" was issued in October to key project personnel. A second list of about 100 titles, dated August 1, and similarly limited in its distribution, was scheduled for the first week in December.

In view of this unsatisfactory situation a number of prominent scientists have urged that the "Bulletin" publish a complete list of the declassified documents. During the last days of November a series of discussions with the Declassification authorities has brought about some clarification of the issues. As a result the "Bulletin" presents below the titles contained in the July 15 and Aug. 1 lists and we plan to publish the additional lists as they are made available.

* * *

A great deal of confusion still exists regarding the methods of making copies of the declassified documents themselves available to both those inside and outside of the Manhattan project.

Some of the sources of this confusion are obvious. Instead of listing them we here confine ourselves to a recital of the sorry state of the present situation and note that authorities have assured us that the distribution of declassified documents will show improvement in the near future. We will report these long-overdue actions as they become effective.

PROJECT DISTRIBUTION:

According to policy of the Research Division of the MED, as of Aug. 1, distribution within the Manhattan project of the documents listed below is to be made as follows:

"Copies of these documents will be distributed by the Information Branch, Research Division, Manhattan District, to every Project installation which normally receives project reports. Coordinating Organization Directors and Responsible Reviewers who do not have access to any Project information service may obtain copies on request. Since deletions in the original documents may have been made by the originating institutions before submission for declassification, this publication (the Aug. 1st list of Declassified Documents) does not constitute authority for declassification of classified copies of documents which may bear the same title and report number and which may have been written by the same authors. The originating institution, only, may use the declassified document received from the Declassification and Publications Branch as authority for the declassification of such classified copies of the original document as contain no Manhattan Project scientific and technical information in excess of that contained in t declassified document. The originating institution is responsib for notifying all recipient institutions or individuals of t declassification of such classified copies as the originati institution has distributed. Classified copies which must rema classified because of deletions made before submission f declassification may be retained in the recipient's file as classifi documents or they may be returned to the originating instituti or destroyed in accordance with the provisions of A.R. 380- Furthermore, this list does not constitute authority for declass fication and release of items of equipment or material mention in the documents (unless specifically written to declassify t items), references used by the author, or similar papers."

* * *

PUBLIC DISTRIBUTION:

Individuals or organizations not presently under contra with the Manhattan project may request copies of the doc ments listed below as follows:

1. Requests for copies of the documents listed under A shou be addressed to the Offices of Technical Services, Departme of Commerce, Washington, D. C.

   It should be noted that documents which have been se to the Offices of Technical Services, Department of Commerc were to have been included in the Department's week publication, "Bibliography of Scientific and Industrial R ports." These documents then were to have been made avai able for public distribution by the same office in the for of microfilm or photostats.

   However, examination of this publication shows that le than twenty of the documents listed in Part A have appeare to date. Furthermore, all of these appeared in the Aug. 9t issue of the publication; none in the issues from Aug 9-No 8. Finally, attention should be called to the joker: "...t Department of Commerce will withhold distribution throug its channels until publication has been accomplished on thos documents to be published in the standard technical journals.

   Clearly the original plan to issue declassified documen to the public through the medium of the OTS of the Depar ment of Commerce has not been a signal success. It is equall obvious that if the OTS has merely become another reposito for Manhattan Project declassified documents instead of distribution center nothing is gained by concealing this fac

2. Requests for documents listed under B should be referred t the authors concerned, since these documents were withhel from the Department of Commerce.

* * *

Unless it is realized that the documents listed below var widely in character and quality the titles alone may b misleading. The documents were written originally for suc disparate purposes as: oral presentation before both popula and scientific groups; publication in newspapers, popula texts, scientific journals and the projected Manhattan Projec Technical Series; industrial and manufacturing specification

Although there is no single source for the public dis semination of all declassified documents, the standard scien tific journals have, in the past few months been publishing number of these documents. We refer our readers to recen issues of the Physical Review, Journal of the America Chemical Society, Review of Scientific Instruments, Scienc Chemical and Engineering News, etc. Thus documents de classified for oral presentation before the American Physica Society are summarized in brief abstracts in Phys. Rev. 70, 99 and 443, 1946.

H. H. G

A List of Manhattan Project Declassified Documents

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Preparation of Polyhaloheptanes V. Fluorination of Chloroperfluoroheptanes with Antimony (V) Fluoride—E. T. McBee, et al.

Preparation of Polyhaloheptanes VI. Identification and Reactions of Polyhalohydrocarbons and Halocarbons—E. T. McBee, et al.

Preparation of Polyhaloxylenes I. The Preparation of Bis-(Trichloromethyl) Benzenes—E. T. McBee, et al.

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Preparation of Polyhaloxylenes IV. Fluorination of Polychloro-Bis (Trichloromethyl) Benzenes—E. T. McBee, et al.

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Technological Control of Atomic Energy Activities

Report Based on Studies by American Scientists

—transmitted to the UN Atomic Energy Commis by the US Delegation

This report is the outcome of a number of studies begun almost a year ago.

Our readers will recall that the early issues of the Bulletin featured a series of articles treating many of the topics in the present report.

Further, it should be noted that the Federation of Atomic Scientists (predecessor of the Federation of American Scientists) instituted a classified study of the problem at the request of the McMahon Committee. This study was cond by members of the FAS who were expert on particular p of the various production methods.

The report published below is a declassified version of s then conducted by two committees appointed by General G (The material compiled by the FAS group was, of course, available to these committees.)

The members of the two committees were:

M. Benedict (Chairman), L. W. Alvarez, L. A. Bliss, S. G. English, A. B. Kinzell, P. Morrison, F. H. English, C. Starr, W. J. Williams.

CHAPTER 1
INTRODUCTION

PURPOSE OF REPORT

The terms of reference of the United Nations Atomic Energy Commission direct it, in part, to make specific proposals:

(1) "For control of atomic energy to the extent necessary to ensure its use only for peaceful purposes;"

(2) "For effective safeguards by way of inspection and other means to protect complying States against the hazards of violations and evasions" of agreements concerning the use of atomic energy.

This report outlines measures of technological control designed to detect violations and evasions of atomic energy agreements without interfering unnecessarily with the peaceful uses of atomic energy. The necessity of preventing violations and evasions may, in some cases, introduce certain complications in the full exploitation of atomic energy for peaceful purposes.

It is essential to note that this report is concerned with technological control of atomic energy and not with political and military aspects of control. The objectives of technological control are to prevent, so far as possible by technical means, and to detect any violations of an agreement not to produce atomic weapons. Technological control should be designed to guard against any nation's securing a military advantage with respect to atomic weapons. The detection of violations would provide an immediate, clearcut warning of any step that might lead to an atomic war. The function of the technologist is to detect such activity when it starts; it is the statesman who must prevent its continuation.

It is difficult to define the amount of activity in the illicit production of atomic weapons which is significant. The illicit construction of a single atomic bomb by means of a decade of successful evasion would not provide an overwhelming advantage, if it can be assumed that it would take another decade to produce a second bomb. But the secret production of one bomb per year would create a definite danger, and the secret production of five or more per year would be disastrous. This report asumes arbitrarily that the minimum unit of non-compliance is the secret production of one atomic bomb per year or of a total of five bombs over any period of time.

FORMS OF EVASION OF TECHNOLOGICAL CONTROL

Evasion of technological control may take the following forms:

(1) Diversion of materials.
(2) Seizure of facilities.
(3) Concealment of operations.
(4) Any combination of the above.

Diversion of Materials

The peaceful use of atomic energy, which should be encouraged, involves the use of the same key raw materials and fissionable materials which are used in atomic weapons; the diversion of these materials to illicit weapon manufacture must be prevented. Fissionable materials which might be diverted would still have to undergo further processing before being fabricated into weapons, but they would already have been through some of the most difficu conspicuous operations. For this reason, the most stringent c of these materials is particularly important. Denaturing kee tain materials from being immediately suitable for easy w manufacture; it is important not to overestimate the degree of p tection thereby provided, as has sometimes been done.*

Seizure of Facilities

Any atomic energy installation devoted to peaceful use is lia seizure by any nation which decides to violate its agreement c Hazard is inherent both in the productive capacity of the fa themselves and in the stocks of raw materials or partially fi products which must, to some extent, be associated with such fac The hazard can be minimized by limiting the type and capac installations and the amount and nature of materials which are essed and stored. The use of denatured material, for instance, what diminishes the hazard. Technological control should ensur all facilities are of such a type and so located that their seizure confer the least military advantage on the outlaw nation.

Concealment

Once the production of atomic weapons has been prohibited the terms of a treaty, the danger will still exist that they c manufacured in hidden or disguised facilities. To do this, it be necessary to secure fissionable material through diversion construct and operate clandestine facilities for production of fissi material. In the latter case, illegal methods of obtaining raw ma at some stage would also be necessary. Technological control s detect concealed facilities of these types and discourage their struction and operation because of the likelihood of their detected.

THE ROLE OF THE ATOMIC DEVELOPMENT AUTHO IN TECHNOLOGICAL CONTROL

The United States Representative proposed to the United N Atomic Energy Commission on June 14, 1946, that an Atomic opment Authority be created to conduct technological control a as to foster the beneficial uses of atomic energy. The existen such an Atomic Development Authority is assumed throughou report; for brevity it will be referred to as the "Authority." organization would have to be international in scope, enjoyin real confidence of all nations and operating under a satisf grant of rights from the various states. It is not within the pr of this report to consider the relations of the Authority to the ex organs of the United Nations. The report has to do with the tions of such an Authority after it is in full operation and i concerned with the transition period during which the Aut would be set up and would gradually assume these functions.

Because of the dual purpose of the Authority, to promot beneficial uses of atomic energy while preventing its use as a we it is natural to use the terms "authorized" and "unauthorized" ations. *Authorized* operations are those which have been made k to and permitted by the Authority and which are controlled through simple registration, licensing and inspection, supervisio

*See chapter 2 for definition of "fissionable materials" and d sion of "denaturing."

ment and operation, the form of control depending on the de- danger inherent in the activity. All other operations in the field nic energy are regarded as illicit and potentially dangerous and med *unauthorized*. They will be unknown to the Authority detects them through one of the many diverse activities sug- for this purpose.

the *control of authorized operations* and the *detection of un- ized operations* a logical division of the activities of the Authority be into three groups:

Strict technological control of dangerous* materials and facilities so as to ensure their use for peaceful purposes only. Such control will include management and operation of dangerous facilities and custody of dangerous materials.

Limited technological control of safe materials and facilities. This will include the registration, licensing, and inspection of safe facilities and the provision of safe materials under appropriate control.

The detection of undeclared and therefore unauthorized activities which could lead to the production of atomic weapons.

s the purpose of later sections of the report to detail by what es and with what estimated success these very different forms vity can be carried on.

s certain that future advances in physical science and atomic technology will require modification of the details and possibly aracter of control. The Authority must have at its disposal for learning of developments while they are still in progress ust never become static. The control methods outlined in port must therefore not be regarded as final, but as effective es at the present stage of development only, and as a guide to ype of measures may be needed in the future. Accordingly, the ity should be empowered to expand or modify its functions t new conditions as they arise.

CHAPTER 2
ATURE OF ATOMIC ENERGY ACTIVITIES

hnological control of atomic energy is rendered difficult by ilarity of the operations leading on the one hand to peaceful d on the other hand to production of atomic bombs. Control ake advantage of such differences as do exist in the operations to the two uses. This chapter describes the materials and ons involved in the utilization of atomic energy, with emphasis se features which have a bearing on technological control.

LISTING OF MATERIALS AND PROCESSES

AL MATERIALS

ent knowledge about atomic structure indicates that the num- isotopes that may be used as practicable sources of nuclear is very limited. Only one such material is found in nature, m-235. Another, which does not occur naturally, is plutonium- rmed from uranium-238 through the absorption of neutrons. sufficiently concentrated, these isotopes may be used either for bombs or for power generation and other peaceful purposes; concentrations it is not practicable to use them for bombs, gh they may still be used, perhaps less efficiently, for peaceful es. A possible third material is uranium-233 which can be rom thorium. Uranium-233 is a material that theoretically at ould be utilized either in the controlled operation of atomic reactors or for the production of bombs.

e general term "fissionable material" as used in this report applies erial containing the isotopes U-235, Pu-239, or U-233 in suffi- oncentration to maintain a self-sustaining nuclear-fission chain n.

35 is present in natural uranium to the extent of 0.71%. oncentration is sufficiently high to permit the use of natural m in the generation of atomic power, but possibly less easily high concentrations of U-235 were available. Naturally occur- ranium does not contain a sufficient concentration of U-235 to its use in bombs.

ural uranium is the only known element occurring in nature can be used alone as a starting point for the release of atomic on the basis of present scientific knowledge. With natural m, Pu-239 can be synthesized; with natural uranium and n, U-233 can be synthesized. If the raw materials and all ma- into which they are converted in the several processes leading to ease of atomic energy could be *completely* controlled, the restriction of atomic energy to peaceful uses could be assured.

PRIMARY AND SECONDARY OPERATIONS

In analyzing the technological control of atomic energy, a useful distinction can be made between processes leading to the release of atomic energy which are carried out solely with naturally occurring fissionable material and those which also make use of enriched or synthesized fissionable materials.

As indicated above, uranium is the only naturally occurring element now known which contains fissionable material. Any operation in which the only fissionable material supplied to the process is U-235 as it occurs in natural uranium is called a "primary operation". Examples of primary operations are the concentration of U-235 in natural uranium, the generation of atomic power from natural uranium, and the manufacture of Pu-239 from natural uranium.

Any operation which utilizes enriched or synthesized fissionable material is called a "secondary operation." The fissionable material may have been produced either in a primary operation or in another secondary operation. An example is a pile which consumes enriched U-235 or Pu-239 and which could be used for power generation or for synthesizing Pu-239 from U-238 or U-233 from thorium. Hence, both natural thorium and natural uranium, as well as enriched materials, are of significance in secondary operations.

OUTLINE OF PRIMARY OPERATIONS

In this report, primary operations are taken to include those of mining, concentrating, and refining uranium ores and preparing uranium compounds, as well as the separation and production of fissionable material from natural uranium. Ores containing uranium are mined, and the uranium values are concentrated in mills and concentrators. Uranium concentrates from these operations are converted to commercial uranium compounds in refineries. These commercial compounds are further processed into feed materials for the plutonium-producing piles or the U-235 separation plants. The yield of fissionable isotopes that can be secured from these primary operations is very small. For example, even with complete recovery, the maximum possible yield of U-235 in an isotope separation plant would be only 0.71% of the natural uranium fed; of course the actual yield is less than this. Control of the large amount of natural uranium needed can therefore be an effective means of preventing the unauthorized production of fissionable isotopes in primary operations.

OUTLINE OF SECONDARY OPERATIONS

The possibility of secondary operations on a large scale has not yet been demonstrated. However, every effort will probably be made to render such operations technically feasible. Although secondary operations could be conducted with relatively small amounts of natural uranium compared to those in primary operations, it is important that they might require comparatively large investments of *enriched* U-235 or other fissionable material. To prevent diversion to unauthorized uses, very strict control of the fissionable material fed into secondary operations is required and equally strict control of any products from which fissionable material may be removed.

MINING AND CONCENTRATING OF URANIUM AND THORIUM

While the occurrence of uranium is fairly widespread, deposits of commercial importance have been operated in only a few localities in the past. The proposed use of this element in the peace-time development of atomic energy may change the criteria of commercial importance so that deposits in many localities will be worked in the future. Thorium deposits are much more plentiful than uranium deposits.

GEOLOGICAL OCCURRENCE

Uranium is not a rare constituent of the earth's crust, but there are few worked deposits. The main published sources of uranium are the Belgian Congo and Canada, but uranium in less rich concentrations is known to exist in many other parts of the earth's surface. Until the discovery of the Canadian deposits, the deposits in the Belgian Congo were the main sources of the world's supply of uranium. The mines of Joachimsthal in Czechoslovakia, made famous as the source of the pitchblende from which Madame Curie first extracted radium, produce some uranium. Occurrences of thorium are reported substantially all over the world.

MINING

Prior to the war pitchblende was mined primarily for the radium content, and carnotite, another uranium-bearing ore, was mined primarily for the vanadium content. With the new demand for uranium,

ngerous" and "safe" activities are distinguished in Chapter 3.

it may quite possibly become the main product in these cases. It is probable that the pre-war world production of thorium-bearing ore could be increased if a demand for the material were created.

Concentrating

Uranium and thorium ores are concentrated prior to chemical processing by normal ore dressing techniques. The degree of concentration effected depends on the initial content of the ore, the distance it must be shipped for chemical processing, and the method of transportation used.

Refining of Uranium

Commercial compounds of uranium are produced from pitchblende by successive processes. It is believed that the unaccounted-for losses in producing pitchblende concentrate, while small in percentage, are great enough to allow deliberate violators an opportunity for diversion in appreciable amounts.

It is important to realize that, until the radium and uranium have been separated, the mixture is radioactive, especially with respect to gamma rays. After the uranium is separated from the radium, it is less radioactive, giving off only alpha and beta rays.

While it appears feasible to attempt the rigorous control of refining operations in which uranium is one of the principal products, it would appear to be considerably more difficult to exercise the same degree of control over an operation in which the uranium is only a by-product of another operation. The full magnitude and importance of this phase of the control problem will be determined by the types of occurrence and the corresponding methods of recovery and will change as the methods improve. The accountability problem will be greater in such cases, and greater uncertainties as to the ultimate disposition of the uranium will exist.

Conversion of Commercial Uranium Compounds to Plant Feed Materials

It is believed that, under proper conditions of operation, unexplained losses in going from commercial uranium compounds to plant feed materials will be similar in amount to those met with in the concentration processes.

ISOTOPE SEPARATION OF URANIUM-235

Types of Processes for Concentrating U-235

The following four processes as well as quite possibly others could be used to concentrate U-235:

(1) Gaseous diffusion process.
(2) Electromagnetic process.
(3) Gas centrifuge process.
(4) Thermal diffusion process.

These four processes have previously been described by K. D. Nichols and J. R. Ruhoff in an article entitled, "Production and Utilization of Uranium-235 and Plutonium-239," in Volume I of *Scientific Information Transmitted to the United Nations Atomic Energy Commission by the United States Representative,* June 14, 1946.

It is probable that any plant for isotope separation which the Authority would undertake to control in the early steps of its existence would be of one of these four types. Other processes might be developed as a result of further study, and the control of isotope separation plants would require restudy if this were the case.

Operating Characteristics of Processes

The quality and quantity of the product of an isotope separation plant may be varied over wide ranges depending upon the plan of operation. In some isotope separation processes, there exists the possibility of changing the characteristics of the individual seperating elements so as to increase the product concentration at the expense of production rate. For other processes, however, there is an upper limit in a given plant to the product concentration, which cannot be exceeded as long as the plant structure is not changed or enriched feed is not used. This upper limit depends on the operating characteristics of the elements of the plant and on the number of these elements connected in series. If the upper limit to the product concentration were below that judged to constitute a military hazard and if the product concentration obtained while operating at efficient feed and product rates had beneficial applications, the plant would be useful for peacetime purposes without being of immediate military value after seizure, at least not until enriched feed were available or the plant altered. The length of time which would elapse before material suitable for bombs could be made in such an isotope separation plant depends on the amount of natural uranium and of enriche[d] seized for use as feed, the inventory of uranium required for plant operation, and the possibility of rearranging the plant t[o] more stages of separating elements in series. This last p[...] varies greatly from one type of process to another.

Isotope separation plants might be dispersed in an att[...] avoid detection. Because of the parallel connection of elem[...] the electromagnetic, thermal diffusion and centrifuge processe[s] of these types could be subdivided into smaller, independe[...] erated plants. The series connection of elements in the gase[...] fusion process renders more difficult the subdivision and di[...] of a plant of this type because of the complex schedule of lar[...] ments of material of different concentrations between the su[...] plants.

It is possible to design an isotope separation plant which [...] take so long to reach a concentration of U-235 sufficiently h[...] bombs that its use for producing bomb material would be imp[...] It is also possible to design a plant in which the amount of U-2[...] ent in sufficient concentration for bombs would be too small t[...] significance in bomb production; such a plant, if seized, woul[d] little hazard, provided that its supply of feed were cut off at t[...] time. However, the large inventory of uranium in a seize[d] might be used in a plant of different design to produce bomb m[...]

Prevention of Diversion from Isotope Separation Plants

Isotope separation plants present some unique problems [...] venting the diversion of valuable process materials. The small [...] of product which is of military significance and the enormous [...] of the plant make physical prevention of diversion, by inspec[...] all outgoing shipments and policing of the process area, of u[...] dependability. This places the principal burden of ensuring [...] tection of diversion on material accounting, through accurate [...] ing and analysis of all materials fed to the plant and removed [...] and accurate inventories of material in process. However, [...] liability of material accounting in U-235 isotope separation p[...] appreciably lower than in conventional chemical plants. Th[...] mary reasons for this low precision are:

(1) The relatively inaccurate character of the assay for u[...] isotopic content.
(2) The tremendous extent of these plants.
(3) The presence of undetectable but legitimate losses of u[...] and U-235 within the process.

Detection of Unauthorized Isotope Separation Plants

The detection of unauthorized isotope separation plants [...] difficult because of their large physical extent, the large staffs [...] to operate them, the large amount of electric or steam powe[r] sumed by them, and the unique equipment employed in thei[r] struction and operation. Dispersion of the electromagnetic, t[...] diffusion, or centrifuge plants might be attempted, to redu[ce] likelihood of their detection, but it is not certain that, as far a[...] cealment is concerned, the reduction in size of these plants [...] offset the increase in their number.

Once inside the buildings of a suspected plant, one can rel[...] easily tell whether the separation of uranium isotopes by one [...] four methods mentioned is going on, because of the unique ch[...] of the equipment and the ready identification of uranium comp[...] in process. There could be no confusion with ordinary pea[...] installations. However, uranium isotope separation plants do n[...] off any unusual chemical or radioactive wastes nor do they emit [...] ily detectable radiation. Consequently, it is necessary to have [...] access to a plant to establish that it is in fact separating ur[...] isotopes.

NUCLEAR CHAIN REACTORS AND ASSOCIATED CHEM[...] PLANTS

Nature and Functions

The subject of nuclear chain reactors is by no means as sim[...] that of isotope separation plants. Isotope separation can be c[...] out, for example, by a single continuous process. The producti[...] nuclear energy, on the other hand, usually involves at least two [...] distinct types of operations: first, the chain reaction itself, [...] releases energy and which produces the neutrons capable of ca[...] transmutation; and second, the chemical reworking of the [...] radioactive materials upon their removal from the pile. Suc[...] working may be required simply for the purpose of extractin[g] sionable material after it has been produced by transmutation, [...] maintain operation of the pile. The chemical processes are [...]

ated and costly but, apart from the need for shielding person- n the high radioactivity, they are parallel to the familiar oper- of the inorganic chemical industry. The piles, however, are t from any existing industrial installations. More attention is e paid to the piles in the discussion which follows. It is to be ered, however, that a large successful pile will require an ed chemical plant of comparable size and cost. For maximum ence this plant will ordinarily be located near the pile, to avoid ardous transport of highly radioactive material.

complexity of the whole problem, enforced by the many tech- lternatives, is further increased by the diverse purposes for hain reacting units may be operated. It will be useful to list ere:

Research in the field of nuclear physics and chemistry.

Production of radioactive materials and nuclear radiation in quantity for therapeutic and technical use.

Production of fissionable material.

Generation of heat, which may be used industrially or con- verted to electrical or mechanical power. This is what is spoken of as "atomic power."

d be pointed out again that any operation of a nuclear chain produces radiation (especially neutrons), radioactive materials, t. Which function the reactor serves is a matter of determin- ortance in its design, although any reactor may to some extent e to perform all four of the listed functions. Industrially, it is at (3) and (4) especially will often go together.

CATION OF PILES

n indication of the various lines likely to be pursued in the nd operation of nuclear reactors, it is appropriate to point out ures which distinguish them.

.—Perhaps the most important distinguishing feature of the he scale on which it is to be operated. This does not mean of the nuclear reactor itself (which depends very little on the of the operations, but mainly on the design of the structure), scale of the whole plant as an engineering unit. The best of this scale, which is reflected in physical size, required serv- l cost, is the rate at which heat is developed, or the power of unit. This heat may be allowed to flow out without special f removal, it may be removed and thrown away by a cooling or it may be converted into electrical or mechanical energy by iate heat engines and electrical generators. The power de- (whether used or not) is proportional to the rate at which akes place. Therefore, by stating the power at which a chain is operated, its scale and in many respects its functions are

research purposes, piles generating from only a few kilowatts few thousand kilowatts will prove adequate for many years . Such installations range from laboratory size up to enter- osting a few million dollars. They evidently can have little c importance as producers of power. For ordinary domestic rs in the United States, we may reckon about ⅓ kilowatt in- er capita. Thus, a reactor producing a thousand kilowatts of some 300 kilowatts of electrical power, could serve a small only 1,000 population. It would be a very large and useful on for research purposes and would be a source of some fis- material, but it would have negligible value for power pro-

production of radioactive materials and radiation for thera- purposes or for technical uses also requires only a modest of power. A pile which produces heat from fission at the rate thousand kilowatts can produce very large amounts of radio- bstances. For instance, a properly designed pile at this power ld produce an activity of the very useful isotope phosphorus- over its short life to the activity of an enormous amount of There are few foreseeable demands for radioactive substances uld not be met by such a comparatively small plant, which uld be of negligible importance as a source of power.

mically significant development of power necessitates the n of piles at such levels that important production, from a standpoint, of fissionable material is possible. The amount of terial actually produced would depend on the design and n of the pile. Heat would be developed at the rate of hun- thousands or even millions of kilowatts. The practical utili- zation of this heat is a technical problem still to be solved.

Types of Piles.—For every scale of developed power, it is possible to construct many types of reactors. The engineering features of all these pile types will be similar, determined primarily by the chosen power level, but the nuclear design and the economics of the mate- rials supplied will of course be different. Various methods of operation are possible. For example, neutrons may be generated in excess of the number required to sustain the reaction. Such neutrons could be ab- sorbed in foreign materials, or could be mainly absorbed in U-238 or in thorium, in which case fissionable material would be produced.

Features of Design.—Other bases for classifying piles are such design features as the way in which fissionable material is charged and with- drawn and the amount of fissionable material present in the pile dur- ing normal operation. If fissionable material is charged and withdrawn periodically, it could be sealed into individually identifiable con- tainers which would be inserted into or removed from the pile only in the presence of the Authority's inspectors. All piles contain in their structure certain amounts of fissionable material. This is an especially important feature from the standpoint of control, since unauthorized closing down of the plant provides an immediate source of fissionable material, which might in some cases be directly usable in weapons. The amount of such material present will vary widely with the design of the pile and with operating procedure.

PREVENTION OF DIVERSION FROM PILES AND ASSOCIATED CHEMICAL PLANTS

Diversion of fissionable materials from a pile can be hindered by security measures designed to prevent theft, by material accounting, and by the fact that certain possible types of piles would cease to oper- ate if material were diverted. Material accounting can be made very strict in piles where feed is charged periodically as slugs or lumps of metal into individual channels; the slugs would be counted and identified as they enter and leave. The fissionable material in a pile is extraordinarily difficult to remove, because it is highly radioactive and must be handled by remote control with great care.

Preventing theft of fissionable materials from the large and ex- tensive chemical plant associated with a pile is much more difficult than from the relatively compact pile itself. After the slugs have been dissolved in the chemical plant, material accounting is less precise. However, diversion would be difficult here because of the great radio- activity of the material. At the end of the chemical process, when the material has been "decontaminated" or freed from radioactive fission products and concentrated in relatively small volume, there is the greatest danger of diversion from its authorized uses. Here the pre- cision of material accounting can be raised somewhat.

The strictness of control required in a pile will depend upon the amount of fissionable material in the pile and the source of the fission- able feed material needed to maintain the reaction. If the Authority supplied all feed material, the stopping of operations after a very short time would be possible by shutting off the feed supply. More effective control of feed material would be possible if the chemical plant were operated separately from the pile. Fuel would then be supplied to the pile and after use in the pile would be returned to a chemical plant for reworking.

ATOMIC BOMBS

Atomic bombs have provided, up to the present, the principal jus- tification for national support of the development of atomic energy. Their incredible destructive power has been widely described. At present, no peaceful economic use of the very violent explosion itself is known. It is probable that the atomic bomb can be used only for destruction. Therefore, the manufacture of atomic bombs should be prohibited under the terms of the treaty.

The cost of the development of the atomic bomb itself was small compared with the cost of the production plants required to furnish the fissionable material. Qualitatively, the operation of producing the atomic bomb was unique. A considerable fraction of the man-years of special research required by the entire project was devoted to the pro- gram. The quality and variety of the personnel were most unusual. It is, of course, true that much less research would be needed to re- peat the effort if atomic weapon design became common knowledge. One of the necessary measures for the detection of bomb production or development would be to obtain information on the activities of scientific and technical personnel. The best control measures for the prevention of bomb manufacture are not those directed against bomb manufacture itself, but those intended to prevent the accumulation by any means of the essential fissionable materials.

DENATURING*

All atomic explosives are based on the raw materials uranium and thorium. In every case the usefulness of the material as an atomic explosive depends to some extent on different properties than those which determine its usefulness for peacetime application. The existence of these differences makes denaturing possible. In every case denaturing is accomplished by adding to the explosive an isotope, which has the same chemical properties. These isotopes cannot be separated by ordinary chemical means. The separation requires plants of the same general type as our plants at Oak Ridge, though not of the same magnitude. The construction of such plants and the use of such plants to process enough material for a significant number of atomic bombs would probably require not less than one nor more than three years. Even if such plants are in existence and ready to operate some months must elapse before bomb production is significant. But unless there is reasonable assurance that such plants do not exist it would be unwise to rely on denaturing to ensure an interval of as much as a year.

For the various atomic explosives the denaturant has a different effect on the explosive properties of the materials. In some cases denaturing will not completely preclude making atomic weapons, but will reduce their effectiveness by a large factor. The effect of the denaturant is also different in the peaceful application of the materials. Further technical information will be required, as will also a much more complete experience of the peacetime uses of atomic energy and its economics, before precise estimates of the value of denaturing can be formulated. Denaturing, though valuable in adding to the flexibility of a system of controls, cannot of itself eliminate the dangers of atomic warfare.

CHAPTER 3

DANGEROUS AND SAFE ACTIVITIES

The extent of control which the Authority would have to exercise over the various activities in the atomic energy field will depend upon the degree to which the particular activity could be used for unauthorized production of atomic bombs. For purposes of this report, activities will be described as "dangerous" and "safe." The atomic energy field will be construed to include all activities making use of uranium, thorium, fissionable materials, and certain radioactive isotopes produced in a pile.

DANGEROUS ACTIVITIES

It is not easy to make a clean-cut distinction between safe and dangerous activities. Any definition may be short lived since it will be predicated on the status of science and the development of processes as now known. In the future, new determinations and definitions will undoubtedly be required, and the Authority should be empowered to make these changes as they become necessary. However, an attempt to make a distinction between the safe and the dangerous can be useful without being completely sharp or fixed for all time.

Activities from which it would be possible to divert militarily significant amounts of fissionable material at any stage of processing from mine to bomb are considered to be dangerous. Certain other activities not involving large amounts of fissionable material are also considered dangerous if deemed primarily useful for the development and manufacture of atomic weapons. Dangerous activities should in every case be under complete control by the Authority and, with certain possible exceptions, should be managed and operated by the Authority.

At present the following activities are considered dangerous:

(1) The mining of uranium and thorium. (The type of control will depend on the character of the deposits.)

(2) The concentrating and refining of uranium or thorium ores or compounds, or of materials containing appreciable quantities of uranium or thorium as by-products.

(3) The production of chemical compounds of uranium and thorium.

(4) The storage and distribution of uranium and thorium in any form.

(5) Construction and operation of plants for separation of the isotopes of any element, if capable, when fed with natural uranium, of producing significant amounts of uranium enriched in U-235.

(6) Construction and operation of all piles capable of producing significant amounts of fissionable material.

(7) **Construction and operation of chemical plants for the** tion of pile products of a nature such as plutonium.

(8) Research on atomic weapons.

A key step in the control of dangerous activities is the co mining, concentrating and refining of uranium and thorium materials. The Authority must make a determination of centage of uranium or thorium content of raw material (i.e., th below which complete control of the mines by the Authorit warranted. This determination is particularly important in of mines which produce these materials as by-products, and w influenced by the rate of production of the particular mines tion.

The construction and operation of isotope separation plants of producing a significant amount of U-235 in significant co tion is dangerous, because such material might be diverted fo bombs. For such plants, the input of material is very large c with the output and the possibilities of diversion are serious. producing material of concentration less than that required fo is still dangerous if, in the event of seizure, the product of plant could be reprocessed to make bomb material.

The construction or operation of piles capable of producin icant amounts of fissionable material is dangerous because the produced, after going through a chemical process, might be bombs. If the Authority furnishes feed materials for power may have to have large production piles with large invent material in process at all times. If nations were permitted to this type of pile, it would be possible over a period of time significant quantities of material. Moreover, these piles would a ready supply of bomb material if seized by any nation. If large pile and associated chemical plant were seized at the san together with normal supplies of materials at each plant, the making the seizure could soon have significant quantities o material on hand.

The operation of chemical plants for the separation of fis material and fission products is listed as a dangerous activity the inventories in process at all times and the extreme diffi accounting for all the material. The processes involved are c with a great deal of piping of material from one place to Diversion of material in the last stages would be relatively eas plants were not operated by the Authority.

Manufacture of atomic bombs should be prohibited un terms of the treaty, but the Authority would need to have c information about the possibilities of bomb production. Th tenance of laboratories for research on this subject is clearly a ous activity and should only be undertaken by the Authority

It can be seen from the foregoing examples that grave resp ity would be placed on the Authority for effective control of able materials and facilities for their production, from the final use. The Authority may not be able to prevent seizure o and stocks of fissionable material, but it should plan to minin military advantage to be gained by seizure. Careful scheduling, storage, and wide dispersion of plants and materials in many c will be required.

Consideration should be given to certain activities which m be *too dangerous* to be operated even by the Authority if rea security against surprise attack and reasonable delay between of installations and bomb attack are to be assured. Manufac bombs is considered to be in this category. Other specific activ combinations of activities should also be considered to de whether they are too dangerous and should consequently be pro

SAFE ACTIVITIES

Examples of safe activities are the use and production of fiss materials in such small quantities as to insignificant for the pro of bombs, the production of radioactive isotopes in specially d piles, the use of radioactive isotopes, and research not concern bomb production. These activities must be licensed and inspe the Authority.

One of the safest activities is the application of radioactive i as tracers in scientific, medical, and technical studies. There m be great advances in this field and there appears to be no rea limiting this work.

It is easy to design small reactors for research purposes, wh denatured U-235 or plutonium as fuel. The design and inspec these reactors should be the responsibility of the Authority. e actors should be designed for operation at a power level so lo be incapable of producing fissionable material in quantities of

*This section is taken from a Press Release of the Department of State, dated April 9, 1946.

ance. Such a reactor could be safe and still provide neutron of great intensity. The material required in any one of these would be of such small quantity and low quality as not to nificant for bomb production. However, some danger would to these reactors if they existed in large numbers.

activity on the *borderline* of safe and dangerous is the high level pile for the development of power for commercial use. pile can be designed to use natural uranium, denatured U-235, tured plutonium as fuel, which would be consumed in the operf the pile. In order to utilize the material contained in the pile nb purposes, it would be necessary to remove the material, deinate the fissionable material of any radioactive fission products, parate it from the denaturant. With large power piles, the s of fissionable material in the feed, in the reactor itself, and in d materials would be large. The Authority should have the ibility for proper design and construction of such piles. Moret the very least, close supervision by the Authority over their on would be required to prevent diversion or improper opera-The degree of danger would of course depend on the number of les.

ARY

ctive control of all atomic energy activities will be required if tions of the world are to have any real degree of assurance sudden atomic bomb attack. The processes are new and comnd accurate inventories are difficult. Small diversion of fissionaterials in the last stages of production over a long period of uld be disastrous. Relatively small diversions anywhere along e from mine to final product would be very dangerous if cart over a long period of time. The longer the processes are in on, the more alert the Authority will have to be to detect diver-In the beginning the overall knowledge and know-how will be , but after a few years knowledge in this field will become widesed. The possibility of successful evasion of controls by a ded nation will then become greater unless the Authority tly reexamines methods of control, stays in the lead of scientific dge and process development, and has been given and exercises t power to broaden the scope of its activities to meet changing ons.

CHAPTER 4

CONTROL OF DANGEROUS ACTIVITIES

DUCTION

e are several considerations which point to the necessity in gen- management and operation of dangerous activities by the Auth-

primary reason for permitting dangerous activities at all is to those material benefits of atomic energy which could not be without those activities. Unless such dangerous activities are ed under authorized auspices, the incentive to derive those by unauthorized means might well be irresistible. Most of the s leading to peaceful uses of atomic energy can also lead to uses; only if these activities are carried on by an effective tional organization can there be assurance that these activities ended for peaceful purposes.

ther important reason for placing dangerous activities directly he Authority is that the measures required for adequate control facilities involved are, in many cases, identical with the measures y associated with sound management and operation of these fa- Included, for example, are accounting for essential materials, of inventories, checking and improving analytical and assaying s, establishing proper sampling procedures, controlling exposure r uranium in piles, and calibrating and improving pile instru- The reduction of unaccounted losses in isotope separation plants e determination of the cause of changes in such losses are no art of efficient operation than a means of preventing diversion nable materials.

he constructive work of the Authority in promoting the beneses of atomic energy through the operation of dangerous s, the Authority would be placed in intimate contact with the al personnel in the scientific and industrial establishments of in which the dangerous facilities are located. This intimate would aid greatly in the detection of unauthorized undertaklso, by giving the Authority the right to conduct dangerous ons, we could insure that the Authority would achieve a nent position in regard to atomic energy technology. Its perwould be better informed and better trained in the use of fise materials for any purpose than the personnel of individual nations. This preeminence would aid the Authority in anticipating technical methods of evading control and in determining how best to organize its detection activities.

Control of dangerous activities will have two principal aspects: control of essential materials and control of dangerous operations.

DISTRIBUTION AND STORAGE OF ESSENTIAL MATERIALS

Control of essential materials will take the form primarily of control over the distribution and storage of raw materials containing uranium or thorium and of fissionable materials obtained therefrom. It is necessary that the Authority control all uranium and thorium from the time it leaves the mine to final consumpion. Rigid control of these materials is a key step in the successful and safe operation of the whole atomic energy program.

LOCATION OF STOCKPILES

As one important material-control measure, the Authority should design and locate its storage and production facilities in such a way that the stocks of raw material and fissionable material on hand in each are as low as is consistent with efficient operation and that the stocks are dispersed as widely as possible. Obviously, mining of uranium and thorium must be conducted where ore deposits are found, but stockpiles, warehouses, and processing plants for raw materials and fissionable materials should be so located that no one nation could derive a preponderant military advantage from the seizure of supplies of materials readily available to it.

SCHEDULING OF MATERIALS

The military value of raw materials and fissionable materials increases with each step in the processing from mining to consumption. The more highly refined the material, the more important it is to keep down the amount of such material on hand at any one time. A second important material-control measure which should be exercised by the Authority is the careful scheduling and coordination of all of its enterprises to produce refined fissionable material only as fast as it is consumed, thus keeping at a minimum the interplant stocks of idle fissionable material, which would constitute a potential military hazard.

GUARDING MATERIALS

A third important material-control measure would be to provide adequate guards to discourage and to detect diversion of raw materials and fissionable materials from warehouses, producing facilities, and shipments in transit. This last requirement means that guards of the Authority must be able to travel with all shipmens of these materials. After the materials have been enriched in U-235 or Pu-239, they should be guarded with greater care than the most precious stones. If the material is so enriched that it could readily be converted to bombs, it must be stored in extremely well protected vaults.

MATERIAL ACCOUNTING

A fourth material-control measure would be reliable accounting for raw materials and fissionable materials at all stages of processing and transfer from the mine to final use. The Authority must maintain accurate records of accountability for all shipments and all operations involving these materials. As the material becomes progressively more concentrated in uranium or thorium or progressively more enriched in U-235 or Pu-239, the reliability required of the material accounting becomes progressively greater. The Authority must weigh, sample, and analyze materials at all stages of the process from mining to consumption. In order that all groups may be kept alert and that confidence may be had concerning the dependability of the material accounting system, it is desirable that the personnel responsible for accounting and analysis at each plant work independently of the other operating personnel. All personnel, however, should be directly responsible to the Authority.

CONTROL OF DANGEROUS FACILITIES IN GENERAL

The ensuing pages are devoted to a discussion of the more involved subject of the control of dangerous producing facilities. In this secion control measures generally applicable to all types of dangerous facilities are taken up. In later sections of this chapter, detailed methods of control for individual facilities are considered. It will be apparent from the discussion that control can best be secured by actual operation and management of most of these facilities.

LOCATION AND CAPACITY

Subject to general principles set forth in the treaty, the Authority must be able to specify the location and capacity of all dangerous facilities. This is necessary, in part, to prevent any of its plants from being located where control may be difficult. The main reason for

this requirement is, however, that producing facilities should be distributed in such a way that seizure of the facilities within any one country or group of countries would not give the aggressor a significant military advantage over other countries.

PROCESS DESIGN OF PLANTS

The Authority must specify the types of processes to be used in all dangerous plants and the concentration and quantities of enriched materials to be handled in them. This is required to insure that the processes to be operated will be amenable to control. For example, the Authority should be able to limit the number of stages and other features of design in a gaseous diffusion process to those which could not under any practicable set of circumstances produce undenatured material suitable for direct use in bombs.

STRUCTURAL DESIGN AND INSPECTION OF CONSTRUCTION

Full control by the Authority over the structural design of proposed facilities is equally as important as control over process design. The structural design of these facilities should be such that they can be controlled to discover diversion. For instance, it should not be possible for hidden channels to be built into the plant, through which material might readily be diverted without detection. As another example, the charging face of a pile should be so designed that it can be readily kept under continuous observation and that any attempt to remove fissionable material can be immediately detected. Proper structural design alone facilitates material accounting by reducing the number of places at which samples need to be withdrawn while taking inventory. Control of structural design will also insure that the inventory of fissionable material in process may be so controlled as to amount, concentration, and distribution as to give the least possible advantage to a nation seizing a plant.

Specification of structural design by the Authority is of no value unless it is followed by inspection of construction at all stages, to insure that the approved design has in fact been followed. Representatives of the Authority must therefore supervise all stages of construction and be able to delay subsequent stages until satisfied that prior construction has been in accordance with the approved drawings.

PREPARATION OF OPERATING SCHEDULES

In order to control the total amount of essential material on hand at different degrees of concentration, the Authority must set operating schedules for all plants handling raw materials or fissionable materials. It must start with an estimate of the expected consumption during a given period and so adjust the production schedules of all its facilities that no shortages or excesses of partially refined materials can develop.

GATE CONTROL

At mines and other producing facilities, the Authority must provide adequate inspection of all persons and shipments leaving the producing area, to prevent undetected movement of essential materials from the area. Gate control of this type is particularly effective in the case of radioactive materials and in the case of relatively unrefined materials where comparatively large amounts must be moved to be of military value. Detection of diversion of radioactive materials is more likely to be effective at piles and associated chemical plants and, possibly, at mines and ore concentrating plants, than at plants handling refined uranium or thorium, which are only weakly radioactive.

CONTROL OF PROCESS AREA

The Authority must also guard the portions of the facilities in which significant amounts of fissionable material are handled. For instance, it should provide continuous surveillance of those stages of a gaseous diffusion plant in which U-235, enriched to a significant degree, is treated. Similarly, for a chemical plant associated with a pile, the portion of the plant in which the valuable material has been largely freed of telltale radioactive contaminants should be heavily and continuously guarded.

MATERIAL ACCOUNTING

Material accounting is one of the most useful means of detecting diversion from certain types of producing facilities. Through material accounting a measurement can be made of the amount of material which has apparently disappeared from a particular producing facility during a particular period.

To account for fissionable material, the weight of all substances which are charged to or withdrawn from the facility during the period is determined and representative samples of these mat[erials] are analyzed for the content of fissionable isotopes. At the begi[nning] and end of the period, an inventory is taken of materials in p[rocess] and of their content of fissionable isotopes. From these measure[ments] the net disappearance of fissionable material can be evaluated.

To carry out such material accounting the Authority woul[d re]quire a competent technical staff with facilities for analyzing fissio[nable] materials and checking scales and other instruments and with [access] to all parts of producing facilities at any time in order to [check] shipments or take samples.

As has been pointed out, the reliability of material accou[nting] and its suitability for detecting diversion differs greatly for the [differ]ent types of facilities. For instance, it is of relatively little val[ue at] mines since it is almost impossible to take a sufficiently accurat[e in]ventory of ore reserves. On the other hand, in certain compact ch[emi]cal processing operations, a very high degree of reliability ca[n be] placed on material accounting.

One limitation of material accounting should be noted. [It is] able to establish only that a certain amount of material is mi[ssing]. It does not detect diversion at the instant of occurrence nor d[oes it] tell by what means loss or diversion has taken place. More[over,] since material accounting makes use of physical measurement[s, its] reliability is limited by the precision to which these measure[ments] can be made. For each type of productive operation, there [is a] percentage of the product rate within which material accou[nting] is not sufficiently precise to establish that diversion has not occu[rred].

ACCESS TO PRODUCING FACILITIES

Although complete access to producing facilities has been ass[umed] in the preceding discussion, it is so important that it may be rest[ated]. In all dangerous activities, the Authority must have immediate a[ccess] to all parts of the facility and to all records relating to its cons[truc]tion and operation and must be able to consult freely with all [op]erating personnel.

CONCLUSION

From the foregoing discussion of the control measures which [the] Authority must institute at dangerous facilities, it is evident th[at in] exercising these control functions it must carry out a large pa[rt of] the normal functions of the manager and operator of the facilitie[s. It] is essential that the control be constructive as well as effective. In [most] cases, it would therefore be necessary for the Authority itself to op[erate] dangerous facilities as a whole.

MINING AND CONCENTRATING OF URANIUM AND THOR[IUM]

The unique role of uranium in the release of atomic energy [has] been stated. Control of the mining of uranium is clearly impor[tant]. Any uranium ore which might be diverted at the mine must be [sub]sequently processed in illegal ore concentrating plants, illegal chem[ical] plants, and illegal piles or isotope separation plants before it is [con]verted into material which can be used directly in atomic bo[mbs]. Each of these subsequent illegal operations provides an additi[onal] opportunity for detection. However, control at the mine is one of [the] most effective steps in helping to prevent the undetected manufac[ture] of atomic bombs.

Prevention of diversion from known mines where uraniu[m is] the important constituent of the ore should not be a very com[pli]cated task. Most of the ore near the surface contains uranium [at] concentrations so low that diversion of significant amounts of uran[ium] requires the handling of large and readily detectable amount[s of] ore. Mining of deeper ore bodies implies a limited number of e[xits] which can be readily found and checked. In cases where uran[ium] is a by-product of a mining operation, the problem is more difficu[lt].

Thorium is less important than uranium in the early stage[s of] development of atomic energy. It will be somewhat more diffi[cult] to control thorium deposits than uranium mines. However, s[ince] the general methods of control are similar, thorium will be inclu[ded] with uranium in the following discussion.

MINE BOUNDARIES

The principal problem which arises in the control of uranium [and] thorium mining is the delineation of the mining area which sho[uld] be controlled by the Authority. Productive mines commonly o[ccur] in regions containing other structures which are geologically sim[ilar] but are too lean in mineral values to warrant economical operat[ion]. These relatively lean deposits might, however, be worked surre[p]tiously as a source of uranium or thorium for unauthorized activi[ties]. Accordingly, when a region is known to contain deposits of uran[ium] or thorium, it will be important for the Authority to make a geolog[ical] and mineralogical survey which is sufficiently extensive to assure [th]at

ignificant deposits of uranium or thorium in that region have located. The Authority must then decide which of the deposits ufficiently rich to warrant placing under control and which are iently lean so that only an occasional check, to establish that ng operations are not being conducted, is adequate to prevent sion.

ORIZED MINES

locations containing relatively rich deposits of uranium or um, the Authority should be empowered, subject to principles orth in the treaty, to decide which part of these deposits is to eveloped for mining and which part should be held as an undeed operating reserve. The Authority should be able to specify the on of shafts and adits and the conditions of operation, including rate of operation in some instances. Control of such developed ons would have as its primary objectives the assurance that the r ore bodies are being mined at the specified rate and that all re mined is being delivered to the concentrating mill. In addi- the Authority must systematically guard undeveloped locations ining rich deposits and must occasionally check the regions con- g leaner deposits, to insure that these regions are not being d. When uranium or thorium can be obtained as by-products her mining operations, appropriate measures must be taken to e the control of all uranium or thorium produced.

or its control measures, the Authority will require continuous cipation in the operations at developed mines, and an inspection quarters and assay and instrument laboratory in each producing n. Estimation of the amount of material which could be diverted out detection in the presence of a well organized control force usly depends on the efficiency and the alertness of that force.

S AND REFINERIES

ontrol of plant operations comprising concentration, purification, conversion of uranium and thorium to salt or metal is somewhat ent from control of mines, in that each of these operations may onducted in a small, guarded area. As concentration operations nvariably closely associated with mining operations, they have broadly covered already.

ach of these operations falls into a single broad pattern with ct to control. This pattern includes an accurate accounting of pt of all uranium or thorium containing materials, a strict con- and inventory of all in-process materials, accurate account- y of shipments of all uranium or thorium containing mate- and a rigid exit-inspection system. The general limitation of ntability resulting from the existence of tailings, waste liquors, ing inaccuracies, and the like, may vary somewhat from plant ant, but the possibility of diversion can, in each case, be kept . Careful study of the problem by the Authority will lead to the lishment of satisfactory standards.

S ISOTOPE SEPARATION PLANTS

he Authority should be empowered to decide in detail the char- stics of plants for the isotope separation of U-235, including capacity and the degree of separation. This is necessary not because of the danger of diversion but because such plants t be used to remove the denaturant from denatured fissionable rials. Thus, if denaturing is to provide any temporary security in vent of seizure of stockpiles of fissionable material, it is necessary isotope separation plants be restricted as to capacity and as to ncrease in concentration which they make possible.

ontrol of isotope separation plants would have the objectives l) establishing that such plants as are authorized cannot be ively used in conjunction with stocks of denatured material ble for potential seizure to produce significant amounts of mate- suitable for bombs, and (2) preventing diversion of significant nts of fissionable material during the long-time operation of plants.

or each type of isotope separation plant there is a limit within n even the strictest control cannot assure that diversion cannot place undetected. The Authority should estimate this limit and ruct only those plants whose aggregate capacity is low enough at if the maximum undetected diversion did occur it would not itute a military hazard.

he control measures generally applicable to dangerous activities n were listed above are all applicable to isotope separation s and need not be repeated here. Since the activities of this ol include many of the activities necessary for plant operation since the control must be carried out in a very strict and effective ner, isotope separation plants for the production of fissionable material should be fully managed and operated by the Authority.

DANGEROUS PILES

From Chapter 2 it should be apparent that there are many possible scales and types of piles. Installations may be built to operate at any power level. It is likely that they would be held to be dangerous if operable at levels which would involve the presence or production of significant quantities of fissionable material. Below such levels, measures of control would still be necessary to prevent long-time violations or rebuilding of the installation, but such small plants would not require operation by the Authority. Larger plants, however, can represent a real military hazard.

In order to control a dangerous pile, the Authority must first make decisions regarding its general characteristics. A determination must be made of the type of pile, including the fuel consumed (natural or enriched material), the original investment of fissionable material, the operating schedule (which determines the amount of fissionable material present), and the design and location of the associated chemical plants. Since such dangerous facilities are potential sources of atomic bomb material, the scale, location, and type of the plant must be chosen in such a way as to minimize the utility and invulnerability of the plant in case of seizure. For example, plants with a large initial investment of fissionable material in suitable concentration for bombs would be more dangerous than those in which such a store was not present.

Only by making such decisions itself can the Authority be satisfied with the final design of the plant. More than that, the Authority must approve the overall design in detail, to insure that the specifications decided upon are in fact met. It must supervise construction to see that the design is actually followed. Finally, it must operate the pile to assure that no misuse is made of it.

Especially important is the insertion of materials in the pile and their removal from the pile. By careful and independent measurement of the total power as it varies with the time, together with full design data and information from experimental calibrating runs on the individual pile installation, it is possible to predict the maximum yield of fissionable material. When this is checked against the product delivered, any diversion should show up. But such a check demands continuous and intimate knowledge of the power level, shut-down times, and operating schedule, as well as the position and amount of all materials inserted and removed. All these requirements demand a resident control staff with such duties as these:

(1) To account for all fuel materials and fissionable products during fabrication, irradiation, storage, and chemical processing.
(2) To supervise all loading and unloading operations and to measure pile power levels and times of irradiation.
(3) To make periodic detailed surveys of all metering and recording equipment and all processing installations to guard against unauthorized changes.
(4) To determine the contamination of equipment, personnel, and the general area within and around the plant. Such knowledge enhances the possibility of detecting any diversion by making possible the detection of stray radioactivity from unauthorized handling of the active materials.

It is estimated that such measures would require a resident control staff of at least fifty technical employees for a sizable plant. Complete freedom within the plant and intimate knowledge of its operation and construction are necessary. Most of the duties of control are the same as the duties required for the successful operation of the plant. It is therefore essential that the operation of dangerous piles be in fact carried out by the Authority itself.

CHEMICAL PLANTS ASSOCIATED WITH PILES

As discussed in Chapter 2, the operation of a pile demands the operation of an associated chemical plant. Convenient handling of the radioactive materials would imply close physical proximity of the two related plants, but this may not be desirable from the standpoint of control. All chemical plants associated with piles are dangerous and should be operated by the Authority. If this were done, the piles themselves might be considered less dangerous in certain cases (see Chapter 5.)

Control of chemical separation plants would be effected by the general control measures outlined above. The following particular aspects of control in these plants are noted. The material charged to these plants will usually be intensely radioactive and so hetero-

geneous that reliable sampling and analysis will not be possible. To prevent diversion, it would therefore be necessary to insure that all fissionable material brought to a chemical separation plant was in fact dissolved and converted to a form in which reliable sampling and analysis could be conducted. Diversion would be more difficult at this stage because of the intense radioactivity of the material. After the fissionable materials were brought into solution, the standard methods of material accounting would be employed for detection of diversion.

Because of the intense radioactivity of the materials in process, it is often necessary to hold them to allow the radiactivity to decay. Nevertheless, operations in a chemical separation plant should be conducted with a minimum delay in the processing of materials in order to reduce the amount of fissionable material on hand.

RESEARCH ON ATOMIC WEAPONS

The production of atomic bombs should be prohibited under the terms of the treaty. However, the Authority would need to know the techniques and basis of bomb production in order to conduct proper denaturing and to understand fully the dangers of diversion and seizure of plants. Wholly new developments in weapons manufacture are by no means to be excluded, and the Authority must be better informed on all possibilities than any individual nation. Such research is clearly dangerous and should be carried on only by the Authority in central laboratories so staffed and so located as to afford a minimum of advantage to any single nation or group of nations in the event of seizure.

CHAPTER 5
CONTROL OF SAFE ACTIVITIES

INTRODUCTION

Four principal types of "safe" activity over which the Authority will need to exercise some degree of control are:

(1) Research in the atomic energy field, excluding atomic explosives.

(2) Production of small quantities of fissionable materials.

(3) Production of radioactive isotopes.

(4) Large-scale power generation in specially designed atomic energy reactors. (These are on the borderline between safe and dangerous activities and require special controls.)

It is felt that the management and operation of these activities may be entrusted to nations or individuals without danger of diversion of militarily significant amounts of fissionable material or without their constituting a serious hazard in the event of seizure, provided sufficient but limited control over them is exercised by the Authority. As will be noted in the following discussion, the frequency with which safe activities need to be inspected by the Authority and the degree of control which the Authority must exercise over their operation depends primarily on the amount of fissionable material on hand in safe installations and the rate at which fissionable material is fed to them and produced by them.[4]

ATOMIC ENERGY RESEARCH

The activity in which the smallest amounts of fissionable material will probably be required and which may therefore be the least intensively controlled by the Authority is research which makes use of fissionable materials. Examples of this type of activity are experiments on neutron absorption cross-sections and other physical and chemical properties of fissionable isotopes and the construction and operation of small nuclear reactors for experimental purposes. The construction and operation of small isotope separation units might be permitted for the preparation of pure isotopes of various non-fissionable elements for nuclear research, provided that these units could not be used for separation of significant amounts of U-235.

Control measures deemed necessary for atomic energy research of the types illustrated above are as follows:

(1) Registration and licensing by the Authority of all laboratories wishing to engage in such research.

(2) Strict accounting by such laboratories to the Authority for all fissionable material produced or consumed in their operations.

(3) Submission of periodic reports by such laboratories to the Authority on their activities.

(4) Frequent visits by the Authority's staff to such laboratories in order to inquire at first hand concerning the research being conducted there. Representatives of the Authority must have complete freedom of access to these laboratories and to their records.

In authorizing laboratories to conduct research on atomic e and in making fissionable materials available to them, the Aut should have the same considerations in mind regarding the disp of facilities and the limitation on the amount of fissionable m available in any one country as have been discussed in conn with dangerous activities.

PRODUCTION OF SMALL QUANTITIES OF FISSIONABL MATERIALS

Laboratory production of small amounts of fissionable ma may be safely left to national or individual operation, provide same control measures are instituted as have been recommend atomic energy research. The Authority must limit the fissi materials produced in this way in any one country so that their a will be too small to constitute a military hazard.

PRODUCTION OF RADIOACTIVE ISOTOPES

One of the most valuable practical consequences of the de ment of atomic energy is the ability to make relatively large am of radioactive isotopes of nearly all the elements. These can be in nuclear reactors containing only a small amount of den material and using up only a few grams of such material pe The degree of control which the Authority will need to ex over these reactors will depend upon the amount of fissionable rial present in them and on the rate of consumption. For installations, the same control measures recommended for a energy research laboratories will suffice. For larger installatio will probably be necessary to have representatives of the Aut present continuously to witness operations.

LARGE SCALE POWER GENERATION

As already mentioned in Chapter 3, large power piles are o borderline between safe and dangerous activities. However, for poses of discussion, they have been put under safe activities i report. Owing to the large amounts of fissionable material p in such piles, the Authority must exercise a much greater deg control over them than over the safe activities just considered.

The design of the reactor must be very carefully checked b Authority to insure that there will be no significant yield of fissio material in the operation of the reactor and that diversion of fi able material can be prevented. For example, the design must be as to make irradiation of uranium in the pile impossible exce places authorized by the Authority. Similarly, the design of the must be such that the removal of fissionable material from it is p cally impossible except at a limited number of easily observable p

Representatives of the Authority must supervise all stages o construction of the reactor to ensure that the unit as built corresp in all details with the approved design.

Prior notice of the anticipated operating schedule must be to the Authority for its approval, so that it can maintain a p balance between production and consumption of fissionable mat

The Authority must maintain a group of inspectors continu at the power plant to assure itself that fissionable materials ar removed from the pile during operation. By proper design of the it should be possible to minimize the size of this staff and its i ference with normal operations. The principal reason for not requ the full management and operation of these installations by Authority is the fact that only an inspection force would be nec and this force would not need to fulfill many of the normal oper functions of the management.

In addition to these special control requirements, the control sures listed under atomic energy research should be in effect large atomic power plants.

Implicit in this discussion of atomic power plants is the nec for all associated chemical plants to be fully managed and operate the Authority. The Authority would supply the fissionable mat for the power plants in accordance with their established power l and design characteristics. The partly consumed materials woul returned to the Authority for reworking in its chemical plants. If chemical plants were operated by nations or individuals in conjun with power plants, the opportunities for diversion would be intole great.

The necessary restrictions on the design and operation of at power plants may make them less attractive economically as a for national or private development. Unfortunately, this is inhe in the dual character of atomic energy technology; installations l enough to be of importance in the generation of power necess contain and consume militarily significant amounts of fissionable terials. The only way these installations can be safely left in nati

ivate hands is by placing serious restrictions on their design and tion. Indeed, it might prove necessary, depending on the design pile, to have operation in the hands of the Authority.

CHAPTER 6

ETECTION OF UNAUTHORIZED ACTIVITIES

UIREMENTS OF ADEQUATE DETECTION MEASURES

etection measures will have to be sufficiently extensive and de- able to promote a feeling of security among all nations and con- e that the Authority is capable and is worthy of the great nsibility placed upon it. Any system of inspection or detection, atter how complete, will be only as good as the individuals oper- the system. The selection of individuals to man the system for etection of unauthorized activities should be given careful consid- n to assure that men of integrity, imagination, and technical etence direct the work. It will be easier to attract this type of nnel if the program involves promoting the safe utilization of c energy as well as inspection to detect unauthorized activities.

thorough study and research into all phases of the atomic energy am, novel and dependable means of detecting certain types of tions can be devised. The personnel directing the detection pro- should participate actively in the research and be fully informed developments in the atomic energy field. The better informed irecting personnel are, the more likely it will be that they and the ization they direct will be able to detect unauthorized activities. challenge of the responsibility for being the best informed men e field should keep the organization alert and active and should ise the confidence of the nations of the world that the danger undetected activities is a minimum.

too great emphasis were placed on the purely negative inspection ion of the organization, men with imagination, initiative, and a ugh understanding of the principles and techniques of the atomic y program would not be so easily attracted to the key positions. e would be a tendency for detection to become a matter of polic- nd espionage measures, and this would be certain to result in fric- In order that the detection program may be a success, it is sary that friction be kept at a minimum and that there be no ds for charging that the Authority is carrying out measures which tute virtual industrial espionage and which disregard the cher- rights of the various nationals involved.

RMATION TO BE OBTAINED FROM DETECTION SURES

DUCTION

ne primary objective of detection measures is to provide the lized information concerning the scientific and industrial activity country necessary to assure the Authority that no unauthorized ties connected with the production of atomic weapons are being d out. The specific detection measures of most value in providing nformation will depend upon the particular type of information red and on the means available for securing it.

enerally speaking, three formal means of acquiring information pen to the Authority. These are:

) The accumulation of information during the Authority's nor- mal control of authorized activities.
) Formal reports on specified topics submitted by individual nations to the Authority.
) Direct inspection by representatives of the Authority whose primary function is to secure specific information for the Auth- ority.

he extent to which the Authority would have to avail itself of formal means for securing information would depend on the de- of cooperation between the Authority and the normal scientific industrial life of a country. The greater the collaboration of the ng scientists and engineers of a country with the members of the ority's staff, the less the need for formal reports and direct in- ion. Under circumstances where extensive use was made of the ties and services of the Authority, information gathered in- ally by the Authority's representatives in the course of their al contacts would provide much of the necessary assurance unauthorized activities were not being undertaken. On the other , under circumstances where extensive use was not made of the ties and services of the Authority, detailed reports on a number pes of scientific and industrial activity and considerable direct ction would be required to provide the Authority with the in- ation needed to establish that unauthorized activities were not undertaken. The five principal types of information which must be secured by the Authority by one means or another are briefly described in the following paragraphs.

Geological Occurrence of Uranium and Thorium

The Authority must know all the locations in the world where significant deposits of uranium and thorium occur and should also be familiar with those areas in which geological formations indicate the probable occurrence of these elements.

Location of Large Mines and Underground Structures

The Authority should be familiar with the location of all large mines to assure itself that such mines are not capable of producing significant amounts of uranium or thorium either directly or as a by-product from normal operations. It should be familiar with the location of all large underground structures to make sure that they are not being used to conceal large industrial plants which might be used for isotope separation or as nuclear reactors.

Large Producers and Consumers of Power

The Authority should have sufficient familiarity with the principal producers and consumers of power and the amounts of power distributed to individual consumers so as to be able to locate those plants making use of enough power to warrant investigation as possible isotope separation plants.

Large Industrial Establishments

One of the premises on which the success of measures for the detection of unauthorized activities is based is that installations capable of converting uranium or thorium, in a relatively short time, into enough atomic bombs to be of military value must be large industrial undertakings. For example, the gaseous diffusion plant at Oak Ridge has a floor area of over 5,500,000 square feet and cost about $500,000,000. It is true that smaller plants are militarily significant and that new installations might well be built at lesser cost. Nevertheless, if the Authority were familiar with the location of all large industrial establishments and knew their primary function, it could be fairly sure that no dangerous unauthorized plants for the production of fissionable materials were in existence.

Activities of Leading Scientists and Engineers

A valuable source of information for the Authority would be the nature of the activities of leading scientists and engineers throughout the world. To date there has been no single phase of the atomic energy program that has not required the combined efforts of large numbers of scientists and engineers. Therefore, the Authority should be interested in the activities of unusually large groups of scientists and engineers assigned to any project. The activities of leading scientists and engineers would furnish valuable information as to the trend of interest in a country. Lack of information concerning the activity of leading scientists and engineers would be a danger signal and might call for investigation by the Authority.

SUGGESTED DETECTION MEASURES

In contrast to the limited number of specific measures discussed earlier in this report for the control of authorized, declared operations and operations carried on exclusively by the Authority, a greater variety of less definite measures would be required for the detection of unauthorized operations. This is due in part to the large number of ingenious ways in which concealment might be attempted, in part to uncertainty as to where illegal installations might be located, and in part to the need for adopting those inspection measures which interfere least with normal activities. This leads to so many possible combinations of inspection measures that only a few examples can be given in this report.

Informal Assembly of Information by the Authority

It has been pointed out that, if the Authority has extensive facilities in the countries of the world and is working intimately with the leading scientists and industrialists of these countries, it would acquire in performing its normal functions most of the information it would need to assure that unauthorized activities were not being undertaken. A number of examples of this will be given.

One of the most important constructive functions of the Authority would be the location and development of deposits of uranium and thorium. For this positive function the Authority should engage in extensive prospecting, which would necessarily acquaint it not only with those locations where uranium and thorium do occur but with those geological formations in which these materials might occur. In carrying out this function, the Authority would have intimate contact with the mining profession throughout the world. This would also

serve to acquaint it with the location of large mines and would help to indicate which of these mines contain significant deposits of radioactive minerals.

By conducting advanced research in nuclear physics, isotope separation, and other subjects related to atomic energy utilization, the staff of the Authority would be in touch with scientists of individual countries who are most familiar with these subjects. This would make it easier for the Authority to keep track of the general fields of endeavor of those scientists who would be most valuable to individual nations if they undertook unauthorized activities in these fields.

Through the production of large amounts of power from atomic energy the Authority would have close contacts with the producers and consumers of power in the principal countries of the world.

In licensing various safe types of activity in the atomic energy field and in providing fissionable materials to establishments working in this field, the Authority would acquire valuable information as to which companies and which engineers or industrialists would most likely be of value in carrying on unauthorized activities.

The Authority, with its own plants and those of its licensees, would be familiar with the location and probable function of all large industrial establishments. A group of intelligent men, with the responsibility of locating large plants and of knowing in a general way what their function is, can secure this information with a surprisingly small number of contacts made during the carrying on of the more constructive affairs of the Authority.

By careful analysis and cross-checking of information in each place during the normal course of the Authority's work, it should be possible to tell which regions of the world or which mines or industrial establishments might possibly be engaged in unauthorized activities and should therefore be subjected to direct inspection.

Formal Reports

To supplement the informal information noted in the preceding section and to minimize the amount of direct inspection employed, the Authority should receive commitments from all participating nations to submit reports on certain technical topics of value in detecting unauthorized activities. These reports, taken at their word, would be of value in describing most of the activities of a country associated with the utilization of atomic energy. The reports should also be examined with a view to detecting deliberate omission or falsification of information since, if such deliberate errors are detected, a very valuable indication of unauthorized activity will have been found. Errors and omissions may be found by intercomparison of reports on different subjects from a single country, intercomparison of reports from different countries, comparison of reports with informal information secured during the normal activities of the Authority, and by spot checks through direct inspection.

The Authority should request reports on the following subjects:

(1) *Mining.*—The Authority should receive reports on all major mining operations.

(2) *Large Plants.*—An initial report and subsequent annual reports on the location and nature of all large plants.

(3) *Engineering Construction.*—Reports on the beginning of all new engineering construction of significant magnitude.

(4) *Power Plants.*—Annual reports on the location of all large power-generating stations.

(5) *Consumers of Power.*—Annual reports on the location of all large users of heat or electric power, giving the nature and amount consumed.

(6) *Specific Equipment or Commodities.*—Periodic reports on the production, shipment, location, and use of the following specific equipment and commodities, which are of particular value in the construction and operation of certain types of isotope separation plants and piles.
- (a) Analytical mass spectrometers.
- (b) Diffusion barriers in quantity.
- (c) Gas centrifuges.
- (d) Electromagnetic isotope-separation units.
- (e) Very pure graphite in large amounts.
- (f) Heavy water.
- (g) Beryllium or beryllium compounds.

Direct Inspection in General

Methods of detecting making use of informal measures or formal reports are valuable preliminaries to the detection of unauth activities but, since they could seldom result in definite proof existence of such activities, they obviously must be supplemen direct inspection of suspected places, mines, and plants.

Direct inspection should not be used indiscriminately, beca the risk of antagonizing a nation or its citizens. The need for a p lar investigation of this type should be demonstrable, and the m of inspection to be employed should be chosen with a view t imizing resentment. In the following discussion it should be re bered that, although the Authority would have the right to i certain places or facilities, it should be so organized that these could not be exercised capriciously.

The direct inspection which the Authority may use to es the existence of unauthorized activities in the atomic energy fie be discussed under the following headings:

(1) Aerial surveys.

(2) Ground surveys.

(3) Inspection of mines and underground structures.

(4) Inspection of industrial facilities.

(5) Special features.

(6) Access.

The principal objectives of direct inspection will be noted a utility evaluated.

Aerial Surveys

Aerial surveys would be a rapid means for receiving general f mation concerning the location of mines, construction projects other industrial activity in large, sparsely settled areas. Their pri disadvantage would be the accumulation of information irreleva the Authority. Aerial surveys would be most useful in rela sparsely settled areas, in which mines or industrial plants are e detect by contrast with their undeveloped surroundings. Since g surveys in sparsely settled areas are tedious and difficult, it is seen aerial and ground surveys complement one another.

Ground Surveys

The principal objectives of ground surveys would be to mines and large industrial buildings, to conduct geologic surve make physical measurements useful in locating unauthorized a (such as seismic measurements to detect blasting), and to s materials for radioactive elements. Ground surveys would specially great value if the Authority were allowed free access areas of a country without advance notice. If advance notice required, it might be possible to stop or conceal unauthorized acti

Generally speaking, investigation by ground parties would pi less irrelevant information than investigation by aerial surve ground party would be almost essential in a crowded, built-up in which an aerial survey cannot identify individual installations. procedure frequently might be to send in a ground party to exa small regions deemed worthy of detailed investigation as the res a broad aerial survey.

Inspection of Mines and Underground Structures

Inspection would be required to determine whether mines capable of producing dangerous amounts of uranium or thorium whether underground structures concealed unauthorized faci such as piles or isotope separation plants. The most satisfactory in which to deal with the location and inspection of mines and u ground structures would be to have an inspection force of pers familiar with the mining of uranium and thorium. These men w talk with prospectors and mining engineers and gather informati new mining developments. They would spot-check suspected struc and would inspect operating mines thought possibly to be prod uranium or thorium as a by-product.

Very large plants to extract elements from sea water are wort inspection to establish that uranium and thorium are not being centrated in them. However, it is not likely that plants would be for this purpose, since there are only a few parts per billion of elements present.

Inspection of Industrial Facilities

The consumption of large amounts of steam or of electric pow one of the distinctive features of plants for concentrating U-235. cordingly, the Authority should have the right to inspect power p and distribution systems for electricity, steam, oil, and gas in ord locate large consumers of power. This is of sufficient value for

ority to have access to such installations, preferably without prior e.

will frequently be desirable for inspectors to enter industrial lishments to determine whether unauthorized activities are being icted or to check information reported by the company or govern- operating the plant. There are obvious difficulties inherent in inspection, but it cannot be dispensed with. Without access of ype, proof of unauthorized activities cannot be secured.

ne fortunate circumstance regarding the inspection of buildings e distinctive character of unauthorized activities in the field of ic energy. Uranium and thorium in process can be readily detect- their radioactivity and chemical properties. Isotope separation s make use of unique types of equipment in large amounts. Piles nlike any other type of industrial structure, with their massive ling, intense internal radioactivity, and enormous rate of heat ation. Inspection of buildings can therefore be reliably con- d by men expert only in atomic energy operations who could nine whether unauthorized activities relating to atomic energy being conducted, without learning much about the character of nate operations.

AL FEATURES

ethods available for detecting isotope separation plants include ing the manufacture and shipment of special equipment used rily in these plants. Certain equipment is necessary to isotope ation plants and of such limited usefulness to other industries application of inspection measures to manufacturers and users of equipment may be worthwhile. These measures might well in- maintenance of a register of all such equipment, periodic ac- ing for it, and inspection of shipments from manufacturers ht likely to be making such equipment. This sort of inspection be applied to the following types of equipment:

) Analytical mass spectrometers (all processes).

) Diffusion barrier (gaseous diffusion process).

) Gas centrifuges with high peripheral speeds (gas centrifuge process).

) Electromagnetic separation units (electromagnetic process).

characteristic of piles is the use of moderator materials to slow the neutrons. Such materials are very pure graphite, heavy , and beryllium. Appropriate inspection measures should be uted in regard to the production, storage, and shipment of these rials.

characteristic of large piles is the extensive cooling facilities re- d. This is of great importance for detection. The only practical ods of removing such large quantities of heat are discharge to al bodies of water or to the atmosphere. Air cooling, being vely inefficient, implies extremely large installations and probably nes impracticable for any but a small scale plant. Water is practi- essential in the cooling of such piles. This implies that these must be constructed near a sizeable natural water supply, i.e., a or river. Accordingly, engineering construction in such areas d be investigated.

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is obvious that all these inspection measures require various de- of access to a country. Without access, direct inspection cannot rformed successfully. Inspectors must be permitted to travel with- estraint and to carry out investigations without undue interfer- Care must be taken to inspect only so far as necessary to confirm sprove suspicions. In some cases inspection of receiving and ship- rooms and platforms might be sufficient. In other cases a thor- inspection, including taking samples from processes, might be sary. In all cases the right of nationals and industries should be ved to the greatest possible extent consistent with fulfillment of inctions of the Authority.

CHAPTER 7

DEGREE OF SECURITY AFFORDED

ne degree of security against the use of atomic weapons afforded e control system described in this report is dependent upon the t to which the following very important conditions are fulfilled.

) The Atomic Development Authority should be staffed with imaginative, technically competent men of the highest integ- rity. Men of this caliber should be afforded adequate incentives to join the organization, such as opportunity to practice their chosen professions and professional recognition of their work with the Authority. It will be of the utmost importance that the staff of the Authority be as clever, resourceful, and techni- cally competent as any national group.

(2) The Authority's purpose of promoting the safe utilization of atomic energy should be an essentially positive one, to which the function of preventing unauthorized activities would be subordinate. If negative activities were dominant, it would be impossible to attract technically able men to the Authority and to secure that degree of national cooperation required for successful functioning of the atomic energy plan.

(3) The Authority should participate actively in research, develop- ment, and production to the end that it will be better informed than any national group concerning the activities it must con- trol and detect.

(4) The Authority should be empowered, and should have suffi- cient flexibility, to change its procedures, privileges, and scale of activities as the use of atomic energy increases and the tech- nology associated with it changes.

(5) In the pursuit of its detection activities, the Authority must have access under reasonable conditions to all areas in all na- tions as described in Chapter 6.

(6) The Authority should be set up promptly and agreement con- cerning its permissible control methods should be reached as soon as possible.

All of these conditions imply a very considerable degree of inter- national cooperation and a real willingness to make the Atomic Development Authority work. Even if these conditions are fulfilled, the technological control measures described in this report provide security only in the following respects:

(1) Providing deterrents, in so far as technical measures can do so, to the use of atomic energy for destructive purposes.

(2) Prevention of surprise use of atomic weapons in quantity by providing unambiguous evidence of the intent of a nation to produce them.

(3) Delay in the production of a militarily useful number of atomic weapons after evidence of intent to produce them has been given.

The degree of security in these respects afforded by the control system described in this report will be evaluated on the assumption that the six favorable conditions just enumerated will be fulfilled.

The measures purposed in Chapters 4 and 5 for the control of authorized activities would provide a degree of security against surprise atomic warfare. They would assuredly prevent large scale diversion of fissionable materials to atomic weapons for a number of years, pro- vided that the scale of authorized operations was low enough so that a small percentage diversion did not represent a serious military haz- ard. However, the longer authorized activities are conducted, the less security would be afforded by the control system because of the pos- sibility that small amounts of material accumulated over a long period of time might build up to a real military advantage. If only authorized facilities were in existence, it is estimated that from three months to one year would have to elapse after seizure of such facilities before a nation intent on making atomic weapons could produce a militarily significant number.

Successful detection of unauthorized activities is subject to much greater uncertainty than control of authorized ones. Nevertheless, ex- cept for the small but finite chance of failure inherent in any form of inspection, it is thought that the interlocking and overlapping nature of the technical inspection measures outlined in Chapter 6 would provide reasonable security against surprise atomic warfare, provided the six conditions given above are fulfilled. This will be true as long as production of militarily significant amounts of fissionable material remains an industrial enterprise of great magnitude. If methods for producing fissionable material are radically simplified, the chances of evading the inspection measures suggested in this report would be greatly increased. The Authority therefore must keep in the forefront of technical developments in the field of atomic energy and must have the power and the competence to adapt its controls to changing con- ditions.

Atomic Energy and U. S. Patent Policy

Part 2: Patent Provisions of the Atomic Energy Act . . . Casper W. Oo

In the Congressional debates preceding enactment of the Atomic Energy Act of 1946 the patent provisions were the subject of more controversy and argument than any other portion of the legislation. A great deal of the discussion disclosed a lack of study of the legislation and a complete failure to appreciate the fundamental effect of the basic provisions of the statute. To understand the patent provisions of the Act it is necessary to review some of the powers entrusted to the Atomic Energy Commission.

The Atomic Energy Act declares it unlawful for any person to manufacture, produce, or refine fissionable material, or to own any facilities for that purpose. [Sec. 4 (a) and (b)]. The Act makes the Commission owner of all facilities for that purpose. [Sec. 4 (c) (1)].

The Act further makes all fissionable material, whenever produced, and all rights therein, the property of the Commission. [Sec. 5 (a) (2); Sec. 9 (a) (1)].

Finally, the Act declares it unlawful for any person to manufacture, deal in, or acquire any device utilizing fissionable material or atomic energy as a military weapon, except upon authorization of the Commission, and the Commission is exclusively authorized to operate in the field of atomic military weapons under such directions as the President may from time to time give the Commission and the armed forces. [Sec. 6].

The implications of the grant of these extensive powers to the Commission and their prohibition to the community at large readily manifest a departure from the general principles of property ownership and freedom of conduct found almost without parallel in our history. Congress was convinced of the need of this exceptional treatment in an extended debate in which it considered the extraordinary problem with which it had to deal, the need for responsible administration of the entire field of atomic energy, the necessity for the greatest possible secrecy of operations in the field until international control had been effected, and the indispensability of assurance that a weapon of the potentialities of atomic energy would remain under government control.

Congress thus removed from private ownership and control the entire field of production of fissionable materials and the entire field of their utilization in military weapons. In addition, by provisions discussed below, the Commission was given a licensing power over the utilization of fissionable materials. [Sec. 7]. The patent provisions of the Act are designed to meet the problems which these innovations in the control of atomic energy raised.

The Atomic Energy Act revokes any patent which may have been granted and forbids further issuance of patents for inventions "useful solely in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon," [Sec. 11-(a) (1)] and revokes any rights and prohibits future acquisition of rights under patents to the extent that the inventions covered by such patents are used " in the production of fissionable material or in the utilization of fissionable material or atomic energy for a military weapon." [Sec. 11 (a) (2)].

These provisions are directed to patents in the two fields entrusted exclusively to the Commssion, the fields of (1) production of fissionable materials, and (2) their utilization in military weapons. Inasmuch as those fields of activity are entirely proscribed to the community at large, there remained little room for normal operation of the principles of the patent system. The patent, we have seen, makes no attempt to license the use of the invention covered by it; on the contrary, the only effect of the patent is to confer on the patentee the power to exclude others from the practice of the patented invention. Thus, the granting of patents upon processes, machines, or even the materials previously required for the production of fissionable materials, a field from which the patentee himself is even excluded by the Act, would be a nullity. Presumably the only actor upon whom the exclusionary power of the patent could be exercised would be the commission, to whom is exclusively entrusted the field in which the invention of the patent is operative. Obviously the grant of such patents would constitute a futile, if not embarrassing, procedure.

In the field of military weapons utilizing fissionable materials the same considerations apply, and in addition, the very important additional consideration that the efficacy of military weapons is frequently dependent upon the maintenance of secrecy with respect to their manufacture and characteristics. The need for secrecy dictates the utter unsuitability of the patent in the field of military weapons. It may seriously be questioned whether the patent lends itself in any way to the business of manufacturing devices that have no other use than as military weapons, as the patent is designed to effect disclosure, a purpose in complete contradiction to the secrecy dema with respect to weapons of war. Cong has in fact made special provision the prolongation of prosecution of pa upon inventions "important to the mament or defense of the United Sta and has empowered the Commissio Patents to order secrecy with respe and to withhold the grant of pa upon inventions where the discl thereof might be "detrimental to the lic safety or defense."[2]

To the extent that the Atomic En Act revokes patent rights already ferred, the statute provides for the ment of "just compensation". [Sec (a) (1) and (2)]. To the extent th forbids future patents it provides an application may be made to the mission for an award, which the Com sion is empowered to grant. [Sec. 11 (2) (C) and (3) (C)].

To insure the enforcement of the visions with respect to inventions in production of fissionable materials their utilization in military weapons Act requires the inventor to report invention to the Commission within days after completing the invention date of enactment of the Atomic En Act, or first learning that the inve is useful in either of the prosc fields. [Sec. 11 (a) (3)].

The Act further revokes any rights ferred by any issued patent and proh the acquisition of rights in patents after granted to exclude the use of inventions covered by such patents the conduct of research or develop activities in the fields specified in tion 3" [Sec. 11 (b)]. Section 3 spec the research and development field which the Commission is directed to courage investigative work in the br est possible terms, including nuclear esses; atomic energy; utilization of fis able and radioactive materials for ical, biological, health, or military poses; industrial uses; and the pr tion of health during research and pro tion.

The extent of this provision of the tute is not clear. Conceivably it coul urged that all equipment used in the s fied research is free of patent con If so, the researcher could procee manufacture all of the apparatus equipment needed for his work, alth that would hardly appear feasible, w out any regard to the patents upon equipment. If that is the interpret to be accorded this provision it is most sweeping of the patent provis in the Act, as it would free from pa

rol every type of device and machine wn, from such simple things as elec- motors to the most specialized type lectronic detectors. Another available rpretation is that only the specific use he equipment in the problem of re- ch or development upon it is free of nt control, and that the manufacture sale of the equipment still falls with- e power of the patentee to exclude.

hat the Act has apparently attempted he express enactment of a vaguely gnized principle of patent law, that experiment with a patented article the sole purpose of gratifying a osophical taste, or curiosity, or for e amusement, is not an infringement he right of the patentee"[3] discussed he first part of this paper. What the ute has attempted is a positive pro- on of the researcher in the field of onable materials against interference or prohibition of his work by the rtion of patent rights.

nother patent provision in the Act hat which empowers, and makes it duty of, the Commission "to declare patent to be affected with the public rest if (A) the invention or dis- ry covered by the patent utilizes or is ntial in the utilization of fissionable erial or atomic energy; and (B) the sing of such invention or discovery r this subsection is necessary to tuate the policies and purposes of Act." [Sec. 11 (c) (1)]. The Act then eeds to license the Commission to such inventions in performing its tions, and to license the use of such ntions to any person licensed by the mission under Section 7 of the Act he extent that such invention is used arrying on the activities authorized is license, subject in both cases to the ment of reasonable royalties to the nt owner. [Sec. 11 (c) (2)].

order to render these licensing pro- ons effective the Act proceeds with express prohibition against the issu- of any injunction under the patent icensed. [Sec. 11 (c) (3)].

hese provisions were bitterly contes- in the debates in the House of Repre- atives. They were recognized as a form compulsory licensing of patented in- ions, an issue which is constantly er debate. The limitations by which licensing was surrounded, although emely broad, were almost entirely rlooked. These may now be examined.

the first place it is necessary that patented invention to which these visions of law apply be one that utili- or is essential in the utilization of onable materials or atomic energy; it is necessary that licensing is essary to effectuate the policies and poses of the Atomic Energy Act. The "policies and purposes" of the Act recited in Sections 1 (a) and (b), generally express the intention that "the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace", and the purpose to provide for major programs relating to atomic energy, to assist and foster private research and development and to encourage maximum scientific progress, dissemination of technical information, to insure the broadest exploitation of the fields, etc. Only when these two limitations are observed may the Commission impress a patent with the declaration that it is affected with the public interest.

The very nature of the entire subject of atomic energy is such that it is difficult to conceive of any phase of its utilization that does not compel a recognition of the public interest which dictated this legislation. What Congress has attempted by this compulsory licensing device is to insure that no license to utilize fissionable materials granted under Section 7 of the Act, which contains elaborately detailed provisions to insure the granting of such licenses on a non-exclusive and non-discriminatory basis, shall be nullified by the owner of a patent who may exercise his patent rights on an exclusive and discriminatory basis.

Such provisions in the law do not present the novelty which was asserted for them during the debates on the legislation. In spite of a public impression to the contrary, the patent law has long contained specific provisions of the same general effect, enabling the United States to employ or have any manufacturer employ for it any patented invention without license from the patent owner[4]. That Act provided that the patent owner could sue in the Court of Claims for reasonable compensation for the use of the patented invention, and denied even that relief to employees of the United States. In 1942 the law was further modified to provide further that the United States could order suspension of the terms of licenses under patents where the head of a Government department believed the royalties prescribed in the license to be unreasonable, and to fix fair and just royalties in the place of those agreed upon by the patent owner and the licensee.[5]

The principle that the public interest may warrant modification of the complete power of the patent owner to select his licensees and fix the terms of his licenses had more recent recognition in the first report of the National Patent Planning Commission:

If it be conceded that operations under licenses from the Atomic Energy Commission are impressed with considerations of the national defense or public health or public safety, and the specified patent involved is necessary to the licensed operation, the compulsory licensing provided for by the Atomic Energy Act would appear to fall within the principle announced by the National Patent Planning Commission[6].

The Act provides for the payment of reasonable royalties for the use of patents licensed under this provision, in the first instance by a Patent Compensation Board conducted by the Commission, and for review of this determination by the Court of Appeals for the District of Columbia. Similar provisions are made to determine and review the just compensation to be paid under the Act for patent rights revoked by the statute, and for the rendering of an award to those who disclose to the Commission inventions in the production of fissionable materials or their utilization in military weapons, although the details of the remedy vary. [Sec. 11 (e) and 13 (a)].

One final provision of the Act [Sec. 11 (d)] requires consideration. Under this paragraph, the Commission is authorized to purchase or condemn with just compensation any invention useful in the production of fissionable material or in its utilization for military weapons, or which utilizes or is essential to the utilization of fissionable material or atomic energy, or any patent or patent application covering such an invention. Provision is made for the determination of the compensation by the Patent Compensation Board, and review of the determination by the Court of Claims or the United States District Court.

In brief review, the Act provides an elaborate but flexible procedure designed to prevent the acquisition of patents in the fields in which the Atomic Energy Commission is given an absolute governmental monopoly, the fields of production and military utilization of fissionable material, and to prevent the assertion of patent rights against research activities in the field of atomic energy or against Commission-licensed operations in the utilization of fissionable materials. The Act also empowers the Commission to purchase patent rights in those fields, and requires the payment of compensation for all rights purchased by the Commission or revoked by the statute.

FOOTNOTES

1. R. S. 4894 (Title 35, U.S. Code, Sec. 37)
2. Act of Oct. 6, 1917 (Title 35, U.S. Code, Sec. 42)
3. Walker on Patents (Deller's Ed.), Sec. 450
4. Act of June 25, 1910 (Title 35, U.S. Code, Sec. 68)
5. Act of Oct. 31, 1942 (Title 35, U.S. Code, Sec. 89)
6. Report of the National Patent Planning Commission (1943) III B. (1)

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EDITORIAL—continued from page 1

might be useful in war technology. Every scientific resul[t is] potentially important in future total war. There is no s[uch] thing as "science for peace" and "science for war," but ev[ery] forward step in science increases the potentialities of mank[ind] in both war and peace.

The fundamental dilemma which the Atomic Energy C[om]mission must face is whether to continue the opportunistic po[licy] of releasing—more or less reluctantly—the scientific infor[ma]tion which at the moment appears to be more or less "innocuo[us,"] and to keep secret the scientific facts which our past experie[nce] has indicated to be particularly relevant to war—technolog[ical] problems. Should we not make the bold decision of actu[ally] following the principle laid down in the Truman-Attlee-K[ing] declaration—that of keeping secret only the technical know-h[ow], the kind of things which were to be found, in peacetime [in] patent applications rather than in scientific journals? Wo[uld] not such a decision, taken on a unilateral basis and with[out] expectation of reciprocity, gain more by assuring our contin[ued] scentific leadership, than harm us by saving others the trou[ble] of finding out certain facts of nature by their own experimen[ts?] Only then could we hope to obtain, on this basis, the co-operat[ion] of scientists in many other countries, a co-operation wh[ich] under the conditions of a free flow of scientific information [will] be as available to us as our own scientific production. E[.R.]

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